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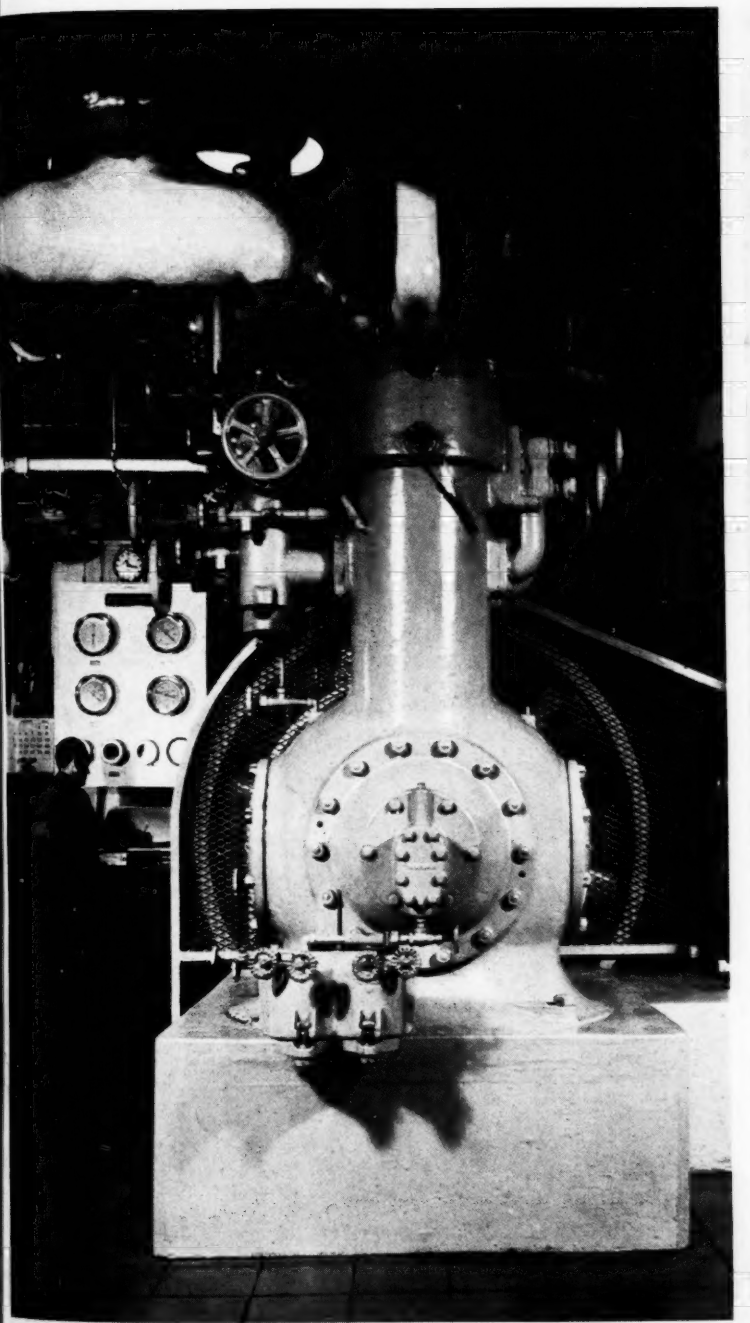
Power Plant ENGINEERING



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COVER: SPLIT-SUCTION, 125-TON, 300-RPM. AMMONIA COMPRESSOR THAT HELPS HANDLE PROCESS COOLING AND AIR CONDITIONING AT KRAFT FOODS CO. PLANT, CHICAGO.

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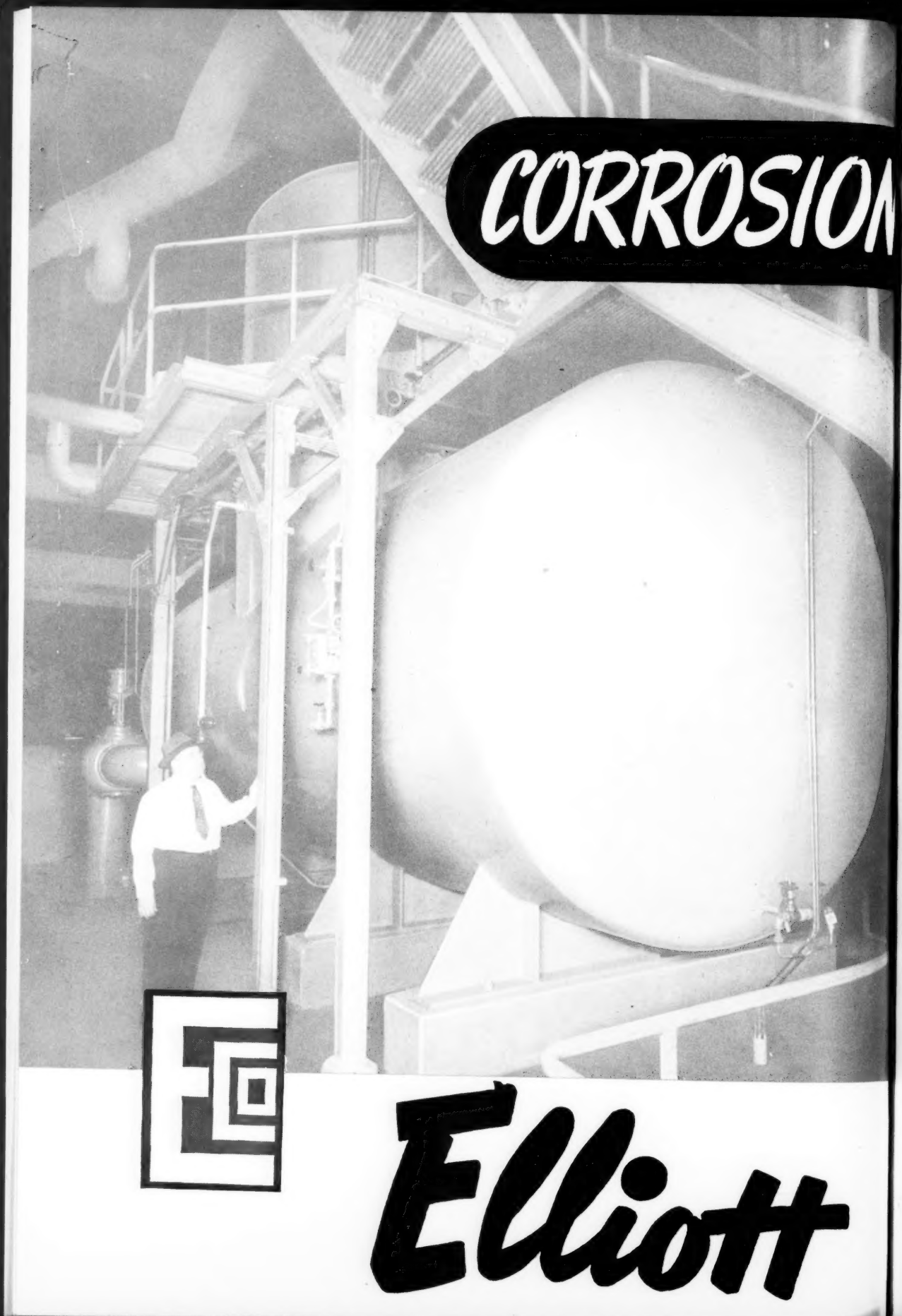
THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

APRIL, 1947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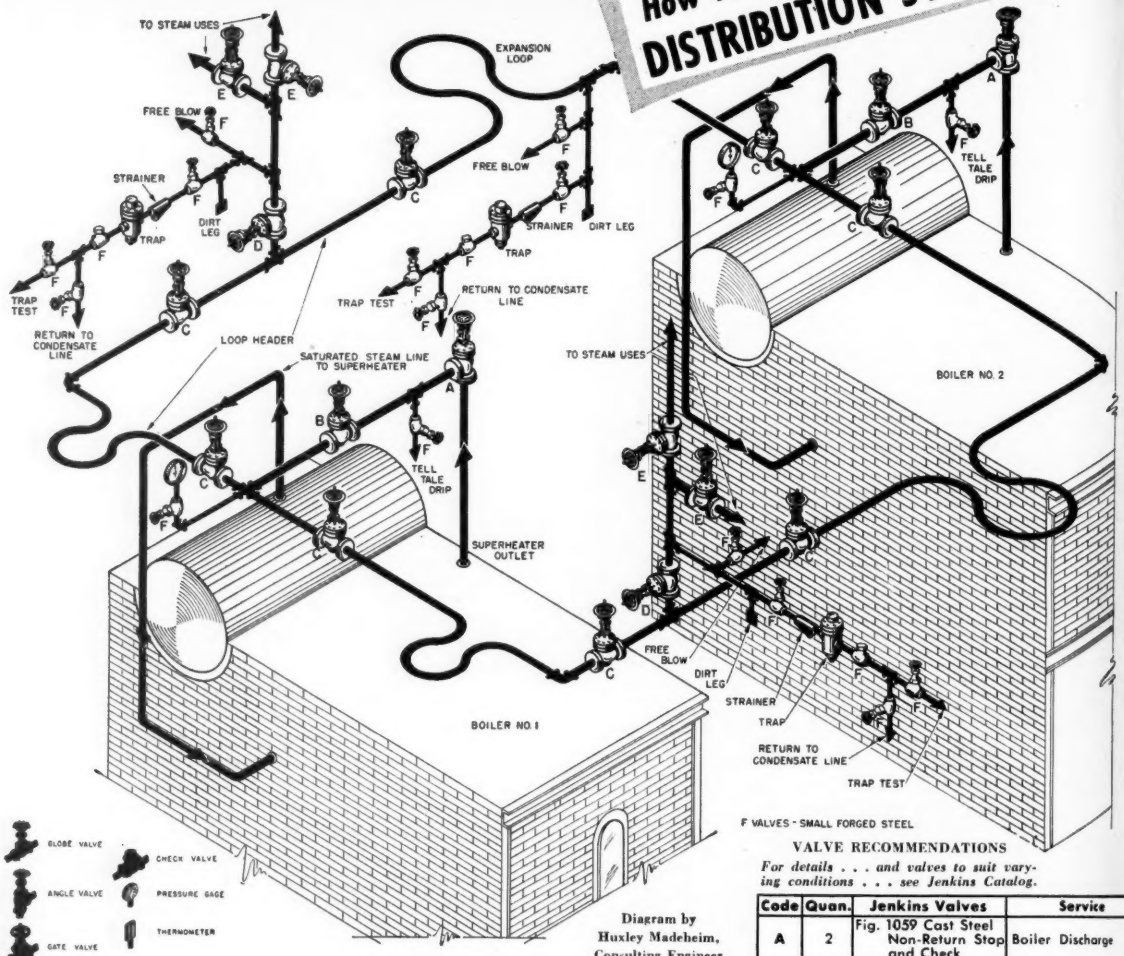
Jenkins PRACTICAL PIPING LAYOUTS 21

How to plan a STEAM DISTRIBUTION SYSTEM



F VALVES - SMALL FORGED STEEL

Diagram by Huxley Madeheim, Consulting Engineer

● **A typical boiler plant** with steam loop and take-offs for various uses is shown in this layout. The two boilers are equipped with angle non-return stop and check valves to prevent return flow into a cold boiler. A gate valve provides a secondary shut off control for complete shutdown with a tell-tale drip to check valve tightness.

Both boilers feed into a loop which (1) allows for expansion (2) assures rejection of moisture and (3) provides two parallel paths for the steam from any one boiler to any one take-off, because of segregation of the take-off and the boilers with valves.

This type of layout permits repair and maintenance without requiring a complete plant shutdown.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation. Copies of Layout No. 21, enlarged, with additional information, will be sent on request... also future Piping Layouts. Just mail coupon.

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A	2	Fig. 1059 Cast Steel Non-Return Stop and Check	Boiler Discharge
B	2	Fig. 1012 Cast Steel Gate	Secondary Boiler Control
C	8	Fig. 1012 Cast Steel Gate	Loop Distribution
D	2	Fig. 1012 Cast Steel Gate	Steam Riser Shut off
E	4	Fig. 1012 Cast Steel Gate	Riser Distribution

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ENGINEERS' PREVIEW

"HUMDINGER" self-contained, self-priming centrifugal pumps, 1½-in. to 8-in., delivering 4500 to 125,000 gpm, have recently-perfected priming device to eliminate automatic valves, counterweights, etc., and guarantee full pumping capacity within 15 seconds. Only one moving part.

★ ★ ★

FOR MEASURING rotating speeds from 300 to 50,000 rpm, a new GE electronic tachometer has been developed. It weighs only 19 lb, can be used to indicate speeds of electric motors, machine tools, automotive and aircraft engines, pumps, fans, blowers, and other types of rotating equipment. It is useful for the production testing of equipment without the necessity for permanent attachments.

★ ★ ★

HELIUM GAS, which is produced in quantity only in the United States under Government auspices, is in increasing demand by industry, according to the Bureau of Mines. New developments include its use in the "heliarc" welder for the welding of magnesium, its use as a leak detector in high vacuum systems, and the employment of helium tracers for mapping the underground structure of oil fields. Only 30 years ago helium cost $2500 per cubic foot and was considered a laboratory curiosity. Today the cost is only 1.5 cents per cubic foot and deliveries are made in tank-car lots. Further details are given in the March issue of *Science Progress*.

★ ★ ★

PUBLIC UNDERSTANDING of "the evils and waste resulting from the inefficient circulation of people and goods" was called one of the most important factors in the solution of the traffic congestion problem at a recent meeting of the ASCE. Without such understanding, efforts to solve the problem will be no more than wishful thinking, said William J. Shea, chief of staff, New York City Planning Department. Chief among the traffic palliatives applied are: prohibition of curb parking and continuous police enforcement; one-way street movement; reduction of left-turning movement; rerouting of transit vehicles and spreading the loading zones in downtown areas; off-peak curb loading and unloading of trucks; and installation and retiming of traffic signals. But there is no panacea. What is needed in every city is a comprehensive and integrated program of street and expressway improvements, additional off-street parking, truck and bus terminals, improved transportation, modernized traffic engineering measures, selected and continuous police enforcement, and a public educated to the evils and waste resulting from the inefficient circulation of people and goods. Any long-range program for effective relief from congestion must be thoroughly understood by property owners and the public generally, and merit their active support if our efforts to solve the problem are to result in other than wishful thinking.

TO MEET an unprecedented demand for instruction in industrial engineering, the School of Engineering of Columbia University will more than double its industrial engineering staff during the Spring Session according to Dean James Kip Finch. Robert T. Livingston, a member of the Columbia engineering faculty since 1921 and recently named Professor of Industrial Engineering, has been appointed to head the department as its new Executive Officer. Dean Finch declared that "registration in this field has increased since the war more rapidly than in any other engineering activity and industrial courses are attracting today not only large numbers of students, but an exceptionally fine group of men with outstanding qualifications. Many men who, before the war, were more interested in materials and design aspects of engineering, have discovered that industrial planning and management, the human side of engineering, pose even more interesting and stimulating problems."

★ ★ ★

AMERICAN ELECTRIC and gas utilities have improved their efficiency of operation, as measured by output per man, more than twice as rapidly in the past four decades as any other major sector of the economy, according to a study published by the National Bureau of Economic Research. Since the turn of the century, labor productivity in the utilities, including electric light and power, manufactured and natural gas, has risen at the remarkable rate of 4 per cent per year. For other sectors of the economy such as manufacturing, agriculture, mining and railroads, comparable gains in labor productivity range below 2 per cent per year. This study has just been issued in book form under the title "Output and Productivity in the Electric and Gas Utilities, 1889-1942."

★ ★ ★

APPARENTLY America must be taught its fire prevention lessons by bitter experience. Many of the most familiar safety regulations and devices now in general use as protection or precaution against fire were adopted only after terrible loss of life and serious property destruction had occurred in some of our worst fires. But today, state and city authorities, aroused by the recent experiences of the Winecoff Hotel fire in Atlanta, tenement fires in New York, several hotel fires in Chicago and other cities, are pushing a program of fire prevention education and remodeling of construction for fire prevention. Enclosing of elevator shafts and stairways, better inspection to discover holes through which fire and gases can pass, installation of fireproof doors, provision of proper exits, remodeling of sprinkler systems, and other measures are being advocated—and above all, education of people themselves. Apparently it is not merely the crowding of our large cities that is responsible for the condition, for some of the worst fires have occurred in relatively small cities and where there is relatively little crowding. It seems to be one of those problems about which it is not safe to generalize and about which something must be done continuously rather than in spurts.

NEW LIGHT-WEIGHT, portable, aluminum air-cooled compressors in 60, 105, 160, 210, 315 cfm are of the V type, except the largest, which has cylinders in a W. Two smaller sizes have 4½-in. stroke, three largest 4-in. Aluminum compressor heads, manifolds, crankcases. Crankshaft mounted on heavy-duty double-row ball bearings. Full force-feed lubrication; air cleaner on each low-pressure cylinder. Available in industrial department, skid, steel wheel, pneumatic-tired trailer and flanged-wheel units for mining, railroad and other work, also for truck mounting.

★ ★ ★

REPORT on the Columbia River Power System, consisting of the Bonneville Power Administration and Power Components of the Bonneville Dam Project and the Columbia Basin Project, Grand Coulee Dam, has just been issued by the Bonneville Power Administration of the U. S. Department of the Interior. This is a very complete report on both the physical and financial operations of the system. Many charts and diagrams and very detailed tabulations cover such factors as revenues from customers, repayment of federal investment, interest on federal investment, energy deliveries and installed capacity, energy production, transmission system and substation capacity, operating results, disposition of the revenue dollar, management of the power resources, customers services, power rates and personnel. Detailed financial statements and auditor's reports as of June 30, 1946 are given at the end of the book.

★ ★ ★

SUPER-CONDUCTIVITY, the phenomena of transmission of electricity without loss due to resistance, occurs in many metals but only at temperatures near absolute zero, −273 C, or −459.7 F. Recently, however, it has been discovered that certain alkali metals in liquid ammonia solutions are super-conductive, after rapid freezing, at temperatures as high as −85 C. The solutions are also good detectors of infra-red light, according to *The Ohmite News*.

★ ★ ★

"WHAT DO you think of it—?" Well, whatever you think about it, your opinion can now be measured and indicated on an Opinion Meter. This device was designed to register the composite opinion of as many as 120 individuals. It consists of a large indicating unit and as many as 120 hand-held stations. On the individual station is a dial calibrated from zero to 100 and an adjustable pointer. The scale from 0 to 50 is the "no" side of the dial and from 50 to 100 is the "yes" side. There is also an "off" position. Inside the indicating unit case are electrical and electronic devices that perform the measuring and indicating function. To register a degree of opinion on a given question, each member of a group turns the pointer on his individual unit to a desired position on the dial. The results from all the individual units are averaged by the indicating unit, and the sweep pointer on the larger dial stops and locks at a number corresponding to that average. What's your opinion of this one?

A DEVICE able to spot holes or imperfections as small as 0.003 in. is the new Fault Detector for inspecting paper, sheet rubber, sheet mica, varnished cloth and various plastic materials. It operates on the principle that various sheet materials have more electrical resistance than air holes or certain foreign particles in the materials. The detector applies an adjustable voltage to the material and measures the different resistivity of the material and of the holes or various imperfections, which will let the current through and indicate a fault in the material. These signals are amplified electronically to actuate a visual or audible alarm or even to actuate automatic control equipment.

★ ★ ★

PACKAGED power unit, the Electrofluid Drive, available in capacities up to 20 hp, is a compact, motorized hydraulic combination of general-purpose a-c induction motor, flange-connected, on a stout housing containing a hydraulic coupling, with shaft extension for driven machines. These may be: heavily flywheeled machinery, compressor, conveyor, cooling tower fan, printing press, textile machine, paper machinery, ball mill, rubber mill, etc. or a speed reducer can be used to drive by chain gear or belt. When motor accelerates quickly or stops suddenly, fluid drive absorbs the shocks and excess energy.

★ ★ ★

WITHIN a few years automobiles, refrigerators, ranges and hospital equipment may be finished with a silicone paint that will retain its original color and gloss indefinitely. Tests of the paint, now being developed by GE, show the silicone product to be highly resistant to severe weather conditions, chemicals and heat. If it works out, colors may be clearer and brighter, also discolorations caused by hot greases, fruit juices, iodine and several chemicals may be prevented. The new paint shows superior resistance to acid and alkali solutions.

★ ★ ★

THOSE WHO follow the very fine articles on the technical and commercial phases of power utility operations published monthly in the *Edison Electric Institute Bulletin* should obtain the recently published Index for Vol. 14 of the Bulletin, January-December 1946. This is available from the Edison Electric Institute, 420 Lexington Avenue, New York City, New York.

★ ★ ★

IMPORTANT USES of alloy cast iron in essential parts are noted at the new station of Staten Island Edison Co. now under construction under the supervision of Gilbert Associates. For inlet and outlet pipe in the cooling and condensing systems of the 25,000-kw turbine generators, cast iron to ASTM specification A 126, Class B, with a nickel content of around 2 per cent, was specified. In the condenser units, nickel alloy cast iron was likewise specified for barrels of the two vertical circulating pumps. Four water box castings, each about 12 ft high, and two reversing valves, each 4 ft in diameter, utilize nickel-molybdenum iron castings.

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS, FURNACES

1 Scotch **Marine Power Boilers**—Bulletin B-3075 is an 8-page bulletin covering complete specifications and descriptions of the company's oil or gas-fired Scotch power boilers. Illustrations of the unit are included and several pages of tabular material regarding its construction and operation are included. Line drawings of several models are dimensioned for supplementary engineering information. Titusville Iron Works Co.

2 **Steam Generators**—This bulletin tells about the company's steam generator which is available for fully automatic operation with any grade of oil. There are 17 sizes in the line from 20 to 500 bhp, for pressures up to 200 psi. 80 per cent thermal efficiency is guaranteed, it is pointed out. Outstanding features of the steam generators are described and a large photo of the unit is shown. Superior Combustion Industries, Inc.

3 **Furnace Wall Construction, Design**—This 36-page manual on industrial heat enclosures, Catalog C-46, is filled with engineering information on the construction and design of suspended walls and arches. Information is presented on air-cooled walls, insulated walls, standardized encasements. An exceptionally useful section is "The Remedy for Air Leakage Through Upper Side Walls." Water wall backing, water wall supports, simplified arch construction, arch variations and many other subjects are covered in this comprehensive booklet. George P. Reintjes Co.

ACCESSORIES

4 **H. P. Power Plant Layout**—A diagrammatic layout, printed in four colors, illustrates the application of the company's apparatus in a typical high-pressure power plant; it has just been issued. Each color in the chart represents steam, water, air, lubrication oil, condensate and other elements passing through power plant equipment. The many uses for the equipment are pictured diagrammatically and a listing of current literature pertaining to each of the products illustrated is given. Schutte & Koerting Co.

5 **Steam Plant Equipment**—Bulletin G-1306, 12 pages, covers the company's line of boiler blow-off valves, water columns and gages, expansion joints, steam traps and strainers, spray nozzles and liquid level indicators. Brief descriptions of each of the items are presented and illustrations are complete. "How to Specify" information is given. Yarnall-Waring Co.

AUXILIARIES, BURNERS

6 **Turbines Maintenance Handbook**—"Maintenance Hints for General Purpose Turbines," is the title of this recently-issued 96-page bulletin. A partial listing of the book's contents will show the wide scope of the subject matter. Some of the subjects covered are: installation, piping, sealing compound, lubricating oil, operation, capacity, inspection, rotor, bearings, glands, speed regulating governor, reduction gears, overspeed trip, emergency tips. Examples are given throughout the booklet and excellent line drawings supplement the descriptive matter. Westinghouse Electric Corp.

7 **Industrial Oil Burner**—"Precision Combustion" is the title of this recently issued 12-page bulletin on the company's oil burner. The folder emphasizes three advantages of the burner: simple flame adjustment; precision air control; pressure-type igniter. Sectional views through the burner and parts supplement the description and schematic diagrams in two colors illustrate the manner in which the flame is "tailored." Other diagrams show adaptation of the burner to eight types of boilers and a full page is used to show typical installations using No. 5 and 6 oil. Other information includes tables of specifications and descriptions of parts. York-Shipley, Inc.

PUMPS, COMPRESSORS

8 **Deep-Well Pumps**—Submersible deep-well motor-pump units are described in Bulletin 46-5000. There are 12 pages in the catalog. The bulletin points out how the pumps (capacities of 7,000 to 20,000 gpm, heads to 1500 ft) are in actuality a packaged pumping station. Sectional views through the pump and casing illustrate operation and construction of the units; tables of capacities and sizes are presented. Photos of actual installations are given. Byron Jackson Co.

9 **Double Suction Pumps**—Bulletin No. 248, 12 pages, is a complete data book on the company's double suction pumps. Presented in the bulletin are specifications and construction details, accompanied by an excellent sectional wash drawing of the pump. Capacity rating tables at various heads and speeds are given. There are 8 double pages of these tables. Other engineering information includes a full page of dimensions for several sizes of pumps; this table is accompanied by a dimensioned line drawing. The American Well Works.

10 **Centrifugal Pumps**—Bulletin W341-B11 is an 8 page catalog describing two types of the company's centrifugal pumps designed for boiler circulation and heater drain service. Drawings supplement the description of the pumps' mounting arrangement, cooling system, etc.. A detailed description of bearings and lubrication, shafts and materials of construction are given. Tabular material includes dimension tables and drawings for pumps from 1¼ to 6 inches. The booklet is well illustrated with line drawings and photographs. Worthington Pump and Machinery Corp.

11 **Compressors Data Book**—There are 64 pages in this recently-isssued Bulletin 3080 on the company's Class PRE synchronous-motor-driven compressors. Complete coverage of the construction and operating advantages of the units is given in the first several pages. Full-page compilations of important advantages resulting from these design features also are given. Extremely large and clear full-color illustrations render the explanations easy to follow. Typical installations are pictured. Ingersoll-Rand.

12 **Pumping Units**—Bulletin 726-C is a 12-page catalog which describes the company's line of "Unipumps." Photographs of the pumps are presented and cross-sectional wash drawings show the construction and operation of the units. Two full page selection tables—one for 60 cycle speeds and one for 50 cycle speeds—for cold water and brine are presented. Another full page of engineering information includes dimensional information on pump and motors; tables are supplemented by dimensioned line drawings. Selection tables and more drawings accompany a page of construction features. An unusually useful section is "How is Reduce Pump Costs." This is accompanied by a full page friction table showing friction of water in pipes for various heads. Typical installations are pictured. The Weinman Pump Mfg. Co.

13 **Chemical and HP Pumps**—Catalog No. 146, 32-pages, is a spiral-bound booklet which describes and gives engineering information on the company's line of controlled volume chemical and high pressure pumps for practically every chemical service. Uses of the pumps in many industries such as chemicals, petroleum, textiles, foods, etc. are outlined. Details of construction which result in outstanding operational advantages are described and illustrated. How precise volume control is obtained with these pumps is the subject of another section of the booklet. A detailed description of many of the parts of the pumps is presented in the center part of the bulletin. Pumps of special design also are shown. Six full pages of capacity-pressure tables are shown and four more pages are given over to a novel chart whereon suggested materials of construction are shown. Milton Roy Pumps.

ELECTRICAL

14 **Steel Fabricated Motor**—This 4-page Bulletin L-12 decribes the latest development in this company's steel fabricated motor, a standardized unit engineered for "low maintenance, high performance and service life." The center spread of the folder points out the various construction features which differ from conventional motors. The section is illustrated with a large wash drawing. Typical installations are pictured. Elliott Company.

FANS, BLOWERS

15 **Fans, Conditioning Equipment**—Bulletin SE-1 describes the company's line of fans, air washers, conditioning units, unit heaters and mechanical draft equipment. Decidedly compact, the bulletin presents on each of its eight pages tables of performance figures, drawings and photos of the equipment, descriptive material pertaining to applications, designs, construction and performance. Clarage Fan Co.

16 **Industrial Fan Systems**—"Fan Systems for Various Industries," is the title of this 32-page bulletin. It describes and illustrates typical examples of blower systems for woodworking industries, dust collecting systems in metal industries, cooling systems for the glass industry and industrial ovens. The need for such systems is explained in each instance and the booklet is well filled with excellent photos of installations. The Kirk & Blum Mfg. Co.

MAINTENANCE

17 **Concrete and Wood Floor Surfacer**—This six-fold folder tells about the company's product for use in patching and resurfacing concrete and wooden floors. Typical examples of the product's use are outlined and a listing of its uses is presented. Detailed directions for application are given. A series of important questions are asked and answered. Stonhard Co.

POWER PLANT ENGINEERING

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18 **The Truth About Waterproofing**—"The Truth About Aquella" is the title of a 32-page report on a product which was originally used in waterproofing porous masonry surfaces of the Maginot line. The booklet tells the story in a logically developed manner from the first application to the Line. It presents letters of commendation from various French Bureaus and also a reproduced letter from the National Bureau of Standards test conducted in 1942. Next is a condensation of the article "Water, Stay Away from my Wall" which appeared originallly in Forbes Magazine and was later reproduced in Reader's Digest. An explanation of the "unauthorized" distribution of an unsigned letter from the National Bureau of Standards is given and a copy of the letter is reproduced. The booklet also contains technical data and photographic and documentary evidence that Aquella really works. Excerpts from letters are reproduced. Prima Products, Inc.

TREATING, FILTERING

19 **Zeolite Water Softenters**—This 8-page bulletin describes Zeolite softener equipment and describes also two common processes for softening water—the Zeolite and lime and soda processes. It also tells when each type should be used. Operating advantages of this company's equipment are pointed out. A sectional view of the company's water softener is presented and on this drawing are pointed out many of the features previously mentioned. The bulletin is extremely well illustrated. The American Water Softener Co.

20 **Soot, Fire-Scale Removal**—This four-page bulletin tells about the company's Oxi Crystals and their function in removing soot, carbon and fire scale from the tubes and heating surfaces of boilers. A detailed description tells of the method of application of the crystals and describes their action. Photos show how boiler interiors appear after use of the crystals. Oxi Corp.

21 **Stopping Scale Without Chemicals**—This bulletin tells about the company's electro neutralizer which is reported to stop scale without the use of chemicals in boilers, condensers, evaporators, internal combustion engines, Diesel installations and hot water systems. The operation of the neutralizer is completely explained and the principle of electro-neutralization is covered. Electro Chemical Engineering Co.

22 **Soot Removers**—"What Do You Know About Soot Removers?" is the title of this new 4-page bulletin. It lists most of the commonly-used soot removers and tabulates the point to which each chemical lowers the ignition point of soot. It also shows what combinations of these chemicals make efficient removers. Helpful hints which have been gleaned and condensed from experiments and tests also are included. A description of the company's compound is included. O'Brien Industries.

23 **Oil Filters**—Several types of oil filters are described in this recently issued 10-page bulletin. Cross-sectional views of the filter are presented and outstanding features of the unit are pointed out in this drawing. Specifications and dimensions for various models are presented in tabular and dimensioned drawing form. Method of operation is completely described. The Briggs Clarifier Co.

24 **Carbon, Soot Remover**—This bulletin tells about the company's carbon, soot and fire-scale remover. The action of this chemical is described and the results of its use are outlined. A description of the chemical is also included and the method by which it is applied is described. Another chemical treatment described in the bulletin is the company's sludge solvent for use in oil-fired systems. Directions for the use of this chemical are also given. Nutmeg Chemical Co.

25 **Boiler Feedwater Handbook**—"Equipment and Methods for Applying Treatment to Boiler Feedwater," is the title of this recently-issued book. The book first describes the problems to be met and the various methods available for doing the job. The various sections then develop the remainder of the solution logically. Pre-Treatment, Feedwater Treatment, Internal Treatment all are covered and each section is supplemented by line drawings of treatment layouts, and tables. Proportioneers, Inc.

26 **Synthetic Ion Exchange**—This 18-page booklet covers the subject of synthetic ion exchange resins and the action of these resins in water treatment. Flow diagrams and cycles of operation in exchange processes and the reduction of alkalinity are presented effectively and chemical aspects of the exchange process are explored. A listing of the advantages of synthetic resin exchangers is given. Illustrations show commercial and industrial deionizing equipment as installed. Applications of the "Amberlites" to water softening, reduction of alkalinity, reduction of total solids comprise one of the most useful sections of the booklet. Methods of use of the Amberlites is another section of the literature. Literature references are given at the end of the bulletin. The Resinous Products and Chemical Co.

27 **Water Softeners Bulletin**—Bulletin 4, eight pages, covers a new line of hot lime-soda water softeners. The five different types of these units which are shown cover a wide range of requirements and the applications of each are concisely explained in the bulletin. Blueprint-type flow diagrams of each type and a general description of the company's hot process phosphate treatment are contained in the booklet. Liquid Conditioning Corp.

INSTRUMENTS, CONTROLS

28 **Manometers Bulletins**—Bulletins 222-B, 343-A, 363, 364, 365 and 366 are all devoted to descriptions of various models of manometers. Specifications of each of the manometers is listed, photos of the manometers are shown and large dimensioned drawings of the units are presented. Outstanding features of each type of manometer are stressed. Builders-Providence, Inc.

29 **Dimensioned Drawings Handbook**—For the first time, this company has combined into a single bulletin a complete set of certified dimensioned drawings covering every available combination of its Flowrator instruments. The book is devoid of all sales information in an effort to condense, into the handiest possible form, comprehensive and accurate dimensional information so important to piping layout draftsmen and designers. Fischer & Porter Co.

30 **Industrial Instrumentation** — Catalog 370 is a 16-page bulletin covering the company's line of indicating, recording and controlling instruments for temperature, pressure, flow, liquid level, humidity and other process variables. Types of control mechanisms are described in the fore part of the bulletin and the remainder of the bulletin presents detailed engineering and construction and operational information on controls and parts. The catalog is well illustrated with photos and sketches and tabular material supplements some of the descriptive matter. The Foxboro Co.

31 **Protective Equipment for Engines** — Catalog 646, 32 pages, covers the company's line of protective equipment for internal combustion engines. Included in the descriptions are safety controls, alarm systems, special indicator systems and automatic plant equipment. Advantages common to the entire line of controls are listed in the fore part of the booklet and detailed descriptions of the various controls follow. Applications for each control are pointed out by example and the control is pictured. Viking Instruments, Inc.

32 **Manual on Temperature Regulators**—Bulletin 464 is a 24-page engineering, operating and maintenance data book. Exceptionally detailed information on "How to Select the Proper Unit for the Job," is included and consists largely of a full-page table, partly colored for emphasis. Complete descriptions and engineering information on all units is presented and accompanying information on elements and accessories is given. Sizing and capacity information is in tabular form; an unusually informative section on installation is complete with drawings and photographs. Operation and maintenance are covered in similar sections. Leslie Co.

VALVES, PIPING

33 **Welded Fittings Data Book**—Bulletin WT-46, an 18-page engineering data book on the company's forged fittings presents a wealth of information on the installation of fittings, their selection and the design of systems. Uses of the three types of outlets are explained in picture and text. Application and structural data tells where and why the fittings are used and shows typical installations. Under the head "Just Four Easy Steps," the bulletin shows the layout, the hole-cutting, tack-welding and welding-in-place details of installation. Handy tips and clearly worded directions make these four steps easy. Tables of temperatures and pressures and tables of stock sizes, dimensions and prices are given as are dimensioned tables and drawings. Bonney Forge & Tool Works.

34 **Steam and Water Valves**—This 4-page bulletin describes seven types of valves —examples of the more than 1500 standard types and sizes made by this company. Line diagrams picture the valve as installed and sectional wash drawings picture the valve itself. Brief descriptions of the unit are given and their outstanding features are listed. Golden-Anderson Valve Specialty Co.

35 **Compressor Valves**—This is a 6-page reprinted article by J. H. H. Voss; the article is titled, "Plant Improvement Through Compressor Valves." Indicator cards are shown and analyzed and photographs of several compressor installations are given. Detailed photos of compressor valves and old and new type springs are presented and their difference are analyzed. J. H. H. Voss Co.

36 **Steam Traps, Filters**—Two 4-page bulletins have just been issued by this company; one of them describes its steam traps and the second one its "Kleen Air" filter. The first of these shows a sectional view of the steam trap and completely describes its action. A table of data including prices is included. Exterior views of other traps in the line are also presented. The bulletin on the filter illustrates the principle of operation, gives a table of specifications and describes the construction of the unit. Kaye & MacDonald, Inc.

37 **Process Tubing Booklet**—There are 8 pages in this bulletin on Electrunite Tubing. The advantages of the tubing are shown in a check list and the manufacturing processes and testing procedures are shown. Applications of the tubing in chemical plants, the sugar industry, oil refineries and the pulp and paper industry are pictured and described briefly. Lists of specifications are given. Two full pages of tabular material tell the properties of stainless analyses and also their corrosion resistance. Another table presents information on size ranges. Republic Steel Corporation, Steel and Tubes Division.

(*Continued on page 158*)

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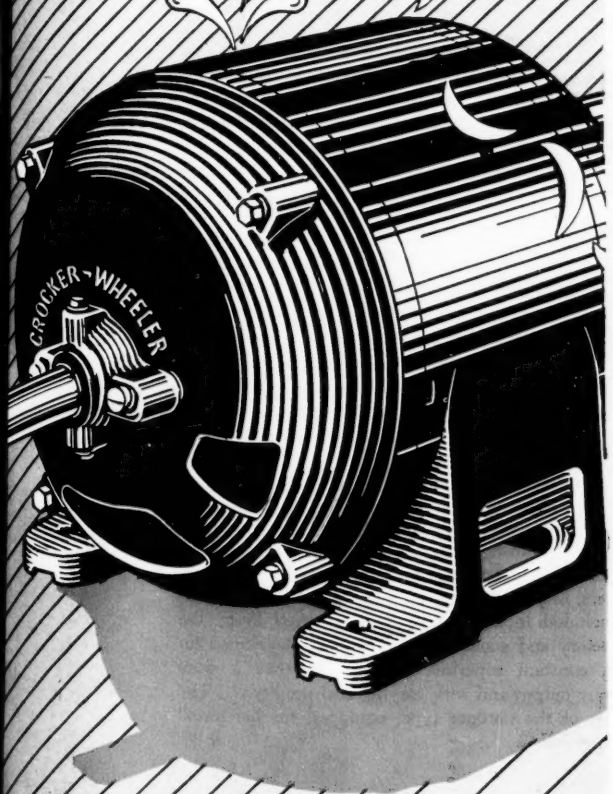
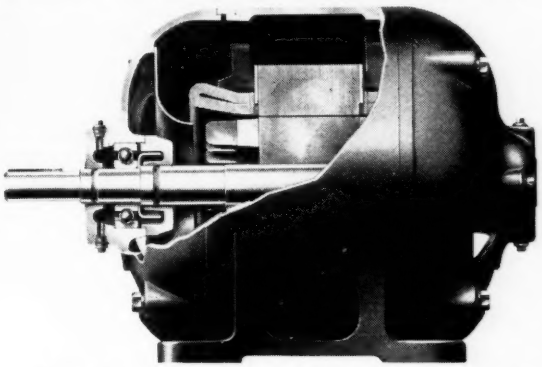
THIS MOTOR SHEDS TROUBLE



The Crocker-Wheeler Protected-type Motor gives you full power, open motor performance—sheltered by a helmet-top housing that keeps dripping liquids, falling metal chips and other foreign matter away from vital working parts. There are no openings for trouble to enter anywhere above the level of the center line of the shaft.

Rated on the same basis as conventional open motors—40 C rise, full-load continuous duty, with a 15 per cent service factor—the motor, in addition to being drip proof and chip proof, is also *neglect proof* to a large extent. Rotors are practically indestructible; *Vinylastic* insulation makes coils dirt, oil and moisture resistant to a high degree; and centrifugal grease seal for ball bearings reduces lubrication attention to once a year or even less often. (Sleeve bearings are optional.)

Protected-type Motors will give you trouble-free service on many jobs for which enclosed and partially-



enclosed motors have been specified in the past—yet, they cost no more than open types.

For complete details, send for your free copy of the new four-page bulletin, SL-300-1 CW-18

CROCKER-WHEELER ELECTRIC MANUFACTURING COMPANY

A Division of Joshua Hendy Iron Works

Branch Offices in Principal Cities

CROCKER-WHEELER AMPERE, N. J.

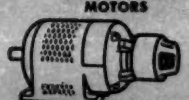
CROCKER WHEELER

A DIVISION OF JOSHUA HENDY IRON WORKS, AMPERE, N. J.

SQUIRREL CAGE MOTORS

WOUND ROTOR MOTORS

DIRECT CURRENT MOTORS

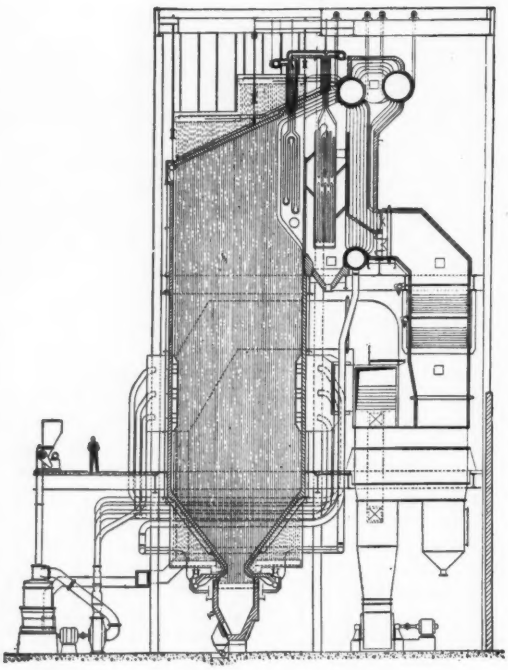


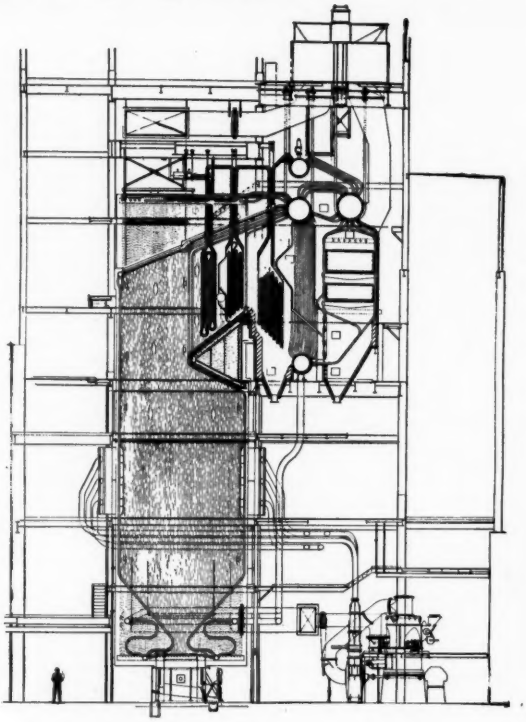
GENERATORS

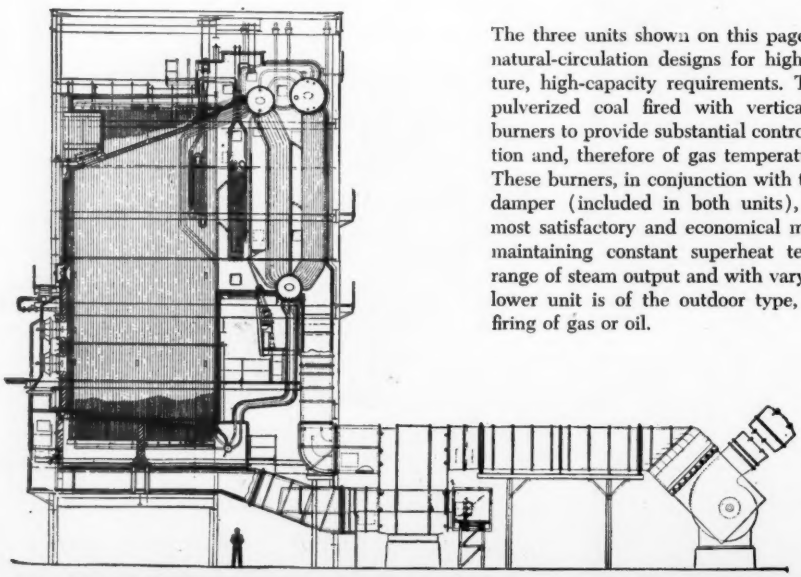
FLEXIBLE COUPLINGS

PRINCIPAL PRESENT-DAY DESIGNS OF

. . . for utility plants







The three units shown on this page typify present-day C-E natural-circulation designs for high-pressure, high-temperature, high-capacity requirements. The two upper units are pulverized coal fired with vertically-adjustable tangential burners to provide substantial control of furnace heat absorption and, therefore of gas temperatures leaving the furnace. These burners, in conjunction with the Montaup type bypass damper (included in both units), have proved to be the most satisfactory and economical method yet developed for maintaining constant superheat temperature over a wide range of steam output and with varying coal quality . . . The lower unit is of the outdoor type, equipped for horizontal firing of gas or oil. B-101

C-E

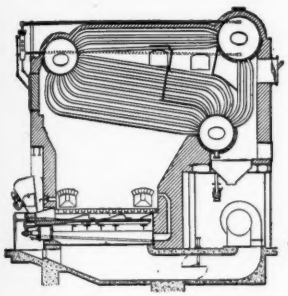
COMBUSTION

C E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

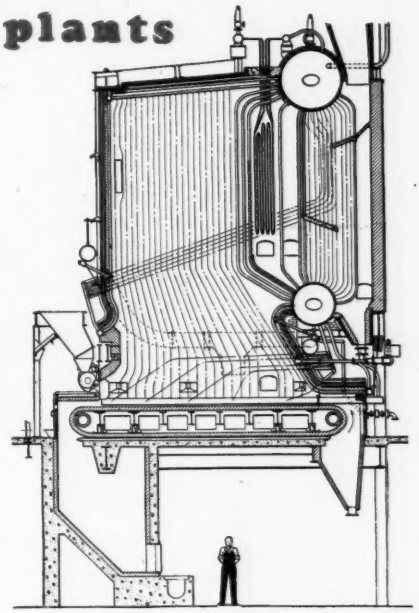
OF C-E STEAM GENERATING UNITS

. . . for industrial plants

Here are seven designs of C-E Steam Generating Units which are finding wide favor among present-day buyers. Collectively, they meet all capacity requirements — from 5,000 to 1,000,000 (or more) pounds of steam per hour — and virtually all conditions of pressure and temperature. Each unit is designed to meet modern standards of performance not only in terms of fuel-burning efficiency but also with respect to such important factors as reliability of operation and low maintenance . . . While not completely representative of the C-E line of boilers and fuel-burning equipment, these units are applicable to the vast majority of today's steam generating needs.

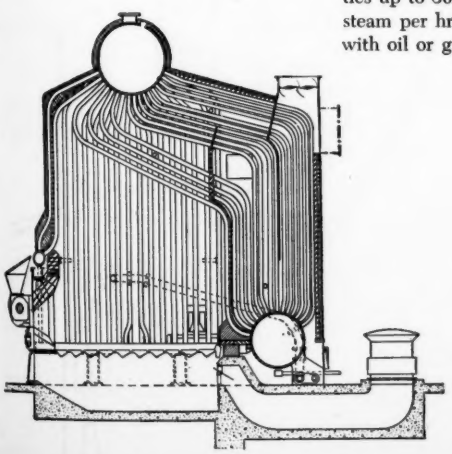


Type VM (Low Head) Boiler fired with Type E Stoker; also adaptable to other types of firing. Built for capacities ranging from about 5,000 to 35,000 lb steam per hr.

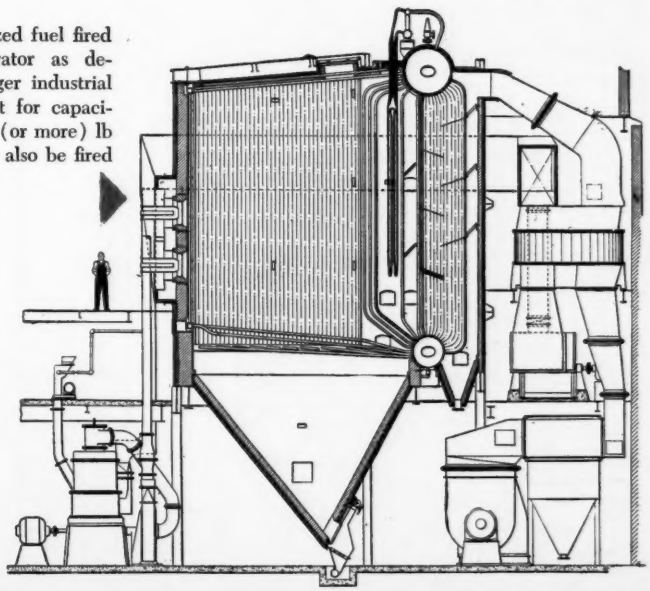


VU Steam Generator fired with C-E Continuous Discharge Spreader Stoker; capacities up to 250,000 lb per hr. Also adaptable for firing by other types of stokers, oil or gas with capacities from 20,000 lb up.

C-E Package Boiler fired with C-E Spreader Stoker; also available with Type E Stoker and for oil or gas firing. Capacities range from about 15,000 to 40,000 (or more) lb per hr.



Typical of pulverized fuel fired VU Steam Generator as designed for the larger industrial requirements. Built for capacities up to 300,000 (or more) lb steam per hr. May also be fired with oil or gas.



ENGINEERING

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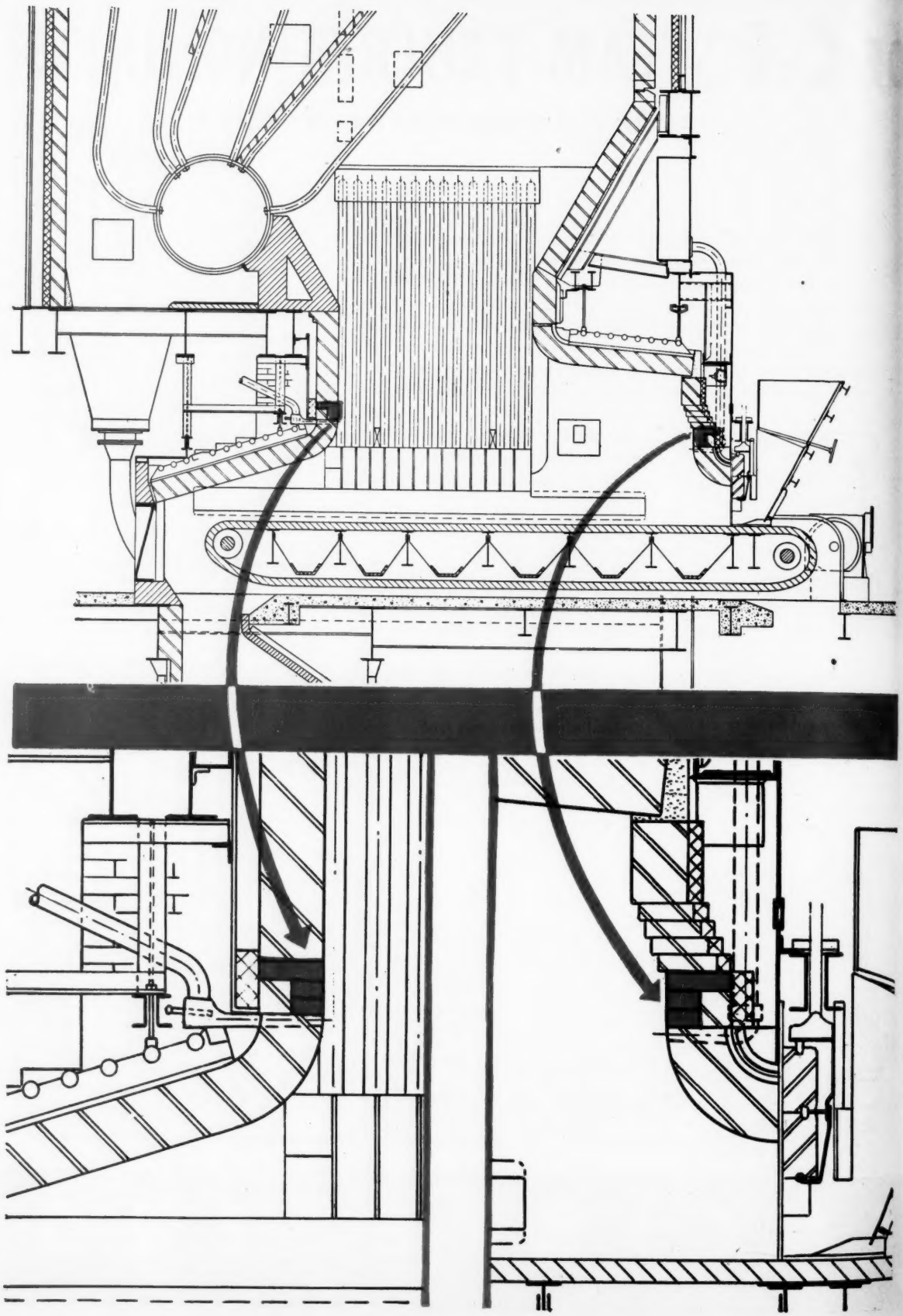


DOING A JOB AT ANOTHER "TROUBLE-SPOT"

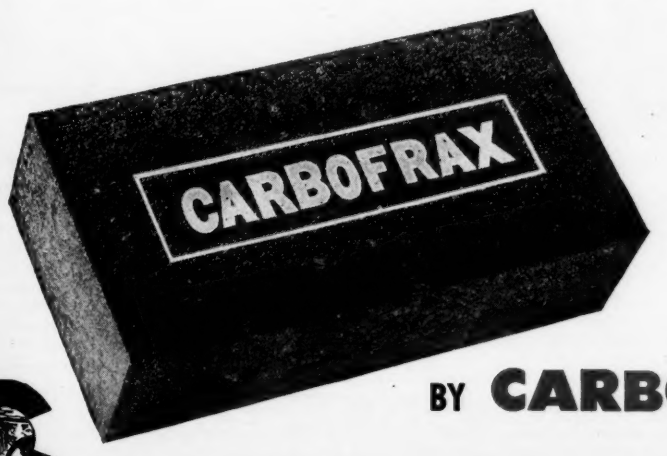
TOUGH PROBLEM SIMPLE SOLUTION

Continuous trouble with uneven secondary air distribution in four large water wall equipped boiler furnaces was this operator's plight.

With ten air nozzles each in the front and rear walls, finger-like slag formed on the clay brick immediately above these openings. The air streams were deflected, preventing uniformly distributed secondary air. Fuel burned unevenly. Costly shutdowns and lowered fuel efficiency resulted.

Installing three courses of CARBOFRAX silicon carbide brick over the air jets, as shown in the illustration, provided the solution to this problem. Clinkers find no anchorage on the smooth surface of the hard, dense CARBOFRAX brickwork. Any slag that accumulates drops off of its own weight. Improved fuel combustion, more continuous on-line service and reduced operating costs have been secured.

Only one of many examples, this experience proves the ability of CARBOFRAX brick to overcome troublesome conditions. Investigate their possibilities for use in your boiler furnaces. A post card to Department H-47 will bring a prompt response. The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



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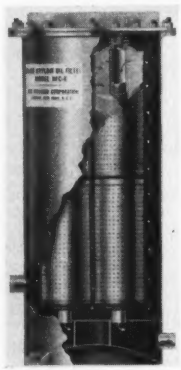
NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

A New Oil Filters The Hilliard Corp. is announcing a new line of lubricating, fuel and industrial oil filters. These units are constructed of steel and utilize from one to eighteen filter cartridges, measuring 7¼ in. by 18 in. This size which has become so popular with Diesel engine operators is known as the "Navy Type."



These oil filter units are available with or without heaters, dependent upon the requirements of the user. The oil is delivered to the inlet of the filter and is forced from the outside of the filter cartridge toward the center and then out through the outlet back to the system, either by means of an auxiliary motor driven pump set or directly from engine or equipment pressure. Hilco units may be operated as by-pass or full-flow filters, depending on the flow rate required.

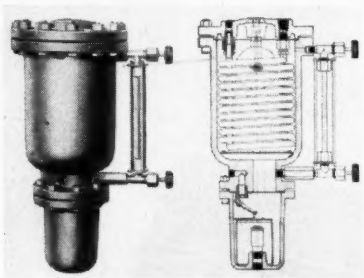
Filter elements available for use in these units are made of Hiltex-Cellulose, a highly efficient grade of filtering material, to handle the additive type oils; or Hilite-Fullers Earth for handling straight run mineral oils. Micronic filtration and high flow rates at relatively low pressures are claimed for these units.

B Refrigerating System Purger Armstrong Machine Works has recently introduced a new non-condensible gas purger for refrigerating systems which in service tests has operated at efficiencies ranging from 98 per cent to 100 per cent. Design is essentially the same as in older Armstrong models except that the refrigerating jacket has been replaced by an internal coil. Use of the coil increases by approximately 50 per cent the condensing surface available for separating non-condensible gases from the refrigerant. In addition, the purger incorporates a new non-condensible gas discharge mechanism in which the ball float used to actuate the valve has been enlarged and the valve itself improved.

The new Purger is offered in two styles: No. 270 with semi-steel body for pressures up to 200 psi and No. 370 with forged steel body for pressures up to 300 psi. Adaptable to systems of virtually any capacity, the purger operates with equal efficiency regardless of whether system pressure is above or below atmospheric.

For maximum efficiency, the refrigerant gas in a refrigerating system must be of high purity. Air or other non-condensible gases present in a refrigerant have the effect of increasing the amount of pressure that must be applied to make it condense into usable liquid form. To apply additional pressure requires use of extra power. The function of the purger is to automatically separate and discharge the non-condensible impurities. To do this, the purger is connected to draw gas from points where the impure gas tends to collect, such as in the high points of the condenser and receiver. This gas is fed into the liquid filled interior of the purger through a small vent in the top of an inverted bucket.

The liquid refrigerant in the purger is kept chilled by the evaporating coil contained in the upper chamber. Gas bubbling up from the inverted bucket is deflected by a baffle to strike the cold coil. Portions that will not condense collect in the top and are released by a simple float controlled needle valve. Excess liquid formed by the portions that condense is discharged (through the valve controlled by the inverted bucket) into the evaporation coil where it helps supply the chilling effect needed to operate the purger. This purging method is applicable to any of the commercial refrigerants, such as ammonia, freon, carbon dioxide, or sulfur dioxide, used in compression type systems. One of the important advantages claimed for the new model is that it reduces loss of gas in purging to practically zero. In the petroleum and chemical industries, the purger has application in gas purification processes.



C Pipe Intersection Compass This tool announced by Martindale Elec. Co., is a great help in accurately marking the lines of intersection of two pipes (of the same or different sizes) which are to be connected to each other in the form of a right angle, other angle, "Y," etc.

The many fields of use for this tool are apparent: the oil field, tin shops, chemical industry are a few. Because of the simplicity of the tool itself the average worker can become expert in its use in a very short time. The saving in time over the old cut-and-try method is considerable and soon pays for the tool.

D Boiler Blowoff Control Automatic regulation of the boiler blowoff is available with Cochrane Corporation's Class 4 and Class 5 Continuous Blowoff Systems. The first three classes utilize flash tanks and flash condensers for recovery of flash steam in addition to heat exchangers. In the newly designed systems a coil-type heat exchanger is used in combination with an automatic temperature regulator which is located in the blowoff outlet of the heat exchanger.

The thermostatic control valve is set to maintain a predetermined temperature difference above the prevailing seasonal makeup water temperature. A

APRIL, 1947

POWER PLANT ENGINEERING

53 W. Jackson Blvd., Chicago 4, Illinois

Please have the manufacturers send me without obligation further information on the equipment indicated by the following letters:

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REPAIRS SPEEDED

DOWNTIME REDUCED

COSTS CUT . . .

by LUNKENHEIMER

Interchangeable Parts

Maintenance men find their job made easier and operating efficiency stepped up by Lunkenheimer interchangeability of parts.

In servicing the Bronze "Renewo" and Iron Body "Ferrenewo" Valves—both regular and plug types—only one *stock of parts* is required. *All* parts (except bodies and bonnet rings) are exactly the same and fit each other perfectly.

For example—if you need a stem, disc, or seat ring for the "RENEWO", you can use the corresponding part of the "FERRENEWO", and vice versa.

Repairs are more quickly and easily made, ordering and handling are simplified. The result: Lower maintenance cost and low ultimate valve cost.

Lunkenheimer part-interchangeability is fully illustrated and described in Circular No. 567. Ask your Lunkenheimer Distributor for a copy, or write direct.

VALVE MAINTENANCE SIMPLIFIED

There are fewer parts to be carried, repairs are more quickly and easily made. The labor, time, and expense of valve maintenance is cut down—'way down!

SEE YOUR LUNKENHEIMER DISTRIBUTOR!

Lunkenheimer Distributors are located in all industrial centers. There is one near you—have him demonstrate with actual samples the interchangeability of parts in "RENEWO" and "FERRENEWO" Valves. It's a big time and money saver for any plant!

• SAVE THIS WAY, TOO! •

For severe throttling service, a regular type can be converted into a plug type, by simply changing the seat and disc, without taking the valve out of the line.

Thus it's not necessary to buy a whole new valve—just a matched set of plug type seat and disc which interchange perfectly in corresponding patterns and sizes in a range of pressures from 150 to 350 lb. S. P.

Lunkenheimer simplicity of design, minimum number of parts, and fine precision workmanship make this and other outstanding economies possible.

Fig. 16-P
Bronze Plug Type
"RENEWO"

Fig. 16
Bronze Regular
"RENEWO"

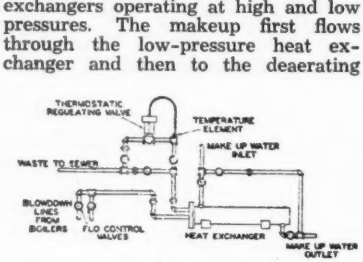
THE LUNKENHEIMER CO., Cincinnati 14, Ohio

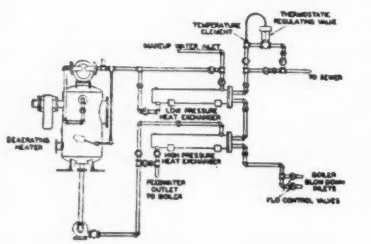
(OFFICES: NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 7.
EXPORT DEPARTMENT: 318-322 HUDSON ST., NEW YORK 13, N. Y.)

change in ratio of blowoff to makeup, which may be required by variation of solids in the makeup water, is readily made by adjustment of the thermostatically controlled blowoff regulating valve.

The Class 4 System employs one heat exchanger in the makeup line to an open heater or direct to the boiler.

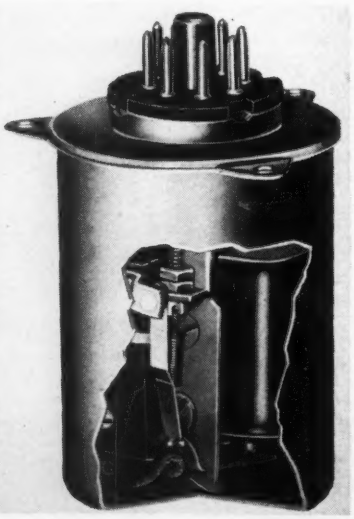
The Class 5 System utilizes two heat exchangers operating at high and low pressures. The makeup first flows through the low-pressure heat exchanger and then to the deaerating





heater. The total boiler feed from the deaerating heater then flows through the high-pressure heat exchanger on the way to the boiler. This system provides an extremely efficient heat recovery system. The boiler blowoff flows countercurrently from the boilers through the high-pressure heat exchanger and then through the low-pressure heat exchanger and the thermostatic regulating valve to waste.

E Sensitive Relay Ward Leonard Electric Co. announces the development of its new Bulletin 108 Sensitive Relay. This sensitive relay is of the plug-in type mounted on a standard octal plug base and enclosed in a cylindrical metal can hermetically sealed against moisture, gases, dust and other detrimental atmospheric conditions. The sensitive relay is provided with a normally open single pole contact having contact ratings of 2 amp 24 v a-c or d-c, 0.75 amp 125 v d-c and 2 amp 125 v a-c. (a-c ratings are non-inductive loads at commercial frequencies).



With a low average coil consumption of 0.056 watts these sensitive relays are suitable for current sensitive applications from 1.3 milli-amperes to 0.54 amp on direct current and are applicable for operation on nominal voltages from 0.1 to 48 v d-c.

Outstanding features include: high accurate sensitivity, low power consumption, compactness (enclosing can measures 2 in. dia by $2\frac{15}{16}$ in. high), no exposed wiring, quickly replaceable and protection against all adverse atmospheric conditions.

F Barrels to Tote Boxes Word has just come to us that Merrill Brothers has just worked out a unique combination from two of their modern tools, which opens up an entirely new field and helps out the scarcity of tote boxes.

The user of this combination is now able to convert steel barrels or kegs into convenient form for storing and conveying small parts or loose material in and around a plant.

With the company's steel drum cutter, the top of any steel barrel is quickly, inexpensively converted into a tote box

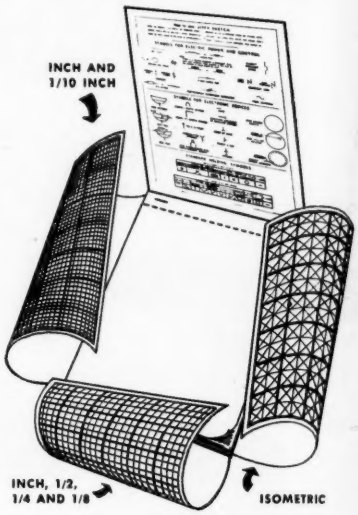
or container for storing or conveying small parts or loose material anywhere in or between plants.

Then, by means of the other member of "the Combination," the Volz Double Action Forged Clamp for lifting plates, angles, barrels, kegs, etc., these cut-away top barrels are quickly and easily lifted and conveyed wherever wanted.

G Sketching Pad Jiffy Sketch is the name of a scale drawing pad that is being introduced by Jiffy Sales Co. It enables one to make properly proportioned drawings without use of ruler, drafting board or T-square, and it may be used in the shop or in the field as easily as in the office.

The Jiffy Sketch pad contains 75 sheets of high quality tracing tissue, enclosed within a cover jacket that consists of four cardboard flaps. Various scales are printed on three of the flaps. To use the pad, you simply fold back the cover flap and then place one of the tissue sheets over the scale you wish to employ. Your drawing is made accurately to scale with the aid of the printed lines which show through the tissue.

In many respects the Jiffy Sketch pad is superior to graph paper. Drawings made on this pad may be blue-printed. There are no ruled lines on the tissue to confuse the drawing. It gives all the advantages of ruled paper, with none of the disadvantages.



The pad measures approximately 9 by 12 in. Sheets are perforated for easy removal. Valuable information is printed on the back of each cover flap—basic mechanical drafting standards; electrical, welding and architectural symbols; decimals of a foot; decimal equivalents of fractions, with circumferences and areas of circles.

H Hose Clamps A new master kit of Punch-Lok bands which will serve practically every need for clamping or banding rubber hose to nipples and fittings and for a wide variety of general repair applications is

now being merchandised by The B. F. Goodrich Co.

Each kit contains a quantity of both open-end and preformed Punch-Lok bands which will find application in many industries and on the farm, where many repairs can be made with this handy clamping device and method.

J Electronic Controller Among the features added since the war to The Foxboro Co. line of instruments for measurement and

Piping jobs move faster when all materials are CRANE

You save time on piping specifications! You save time in ordering materials! You save on installation time! Standardizing on Crane equipment does all that—and more—for you.

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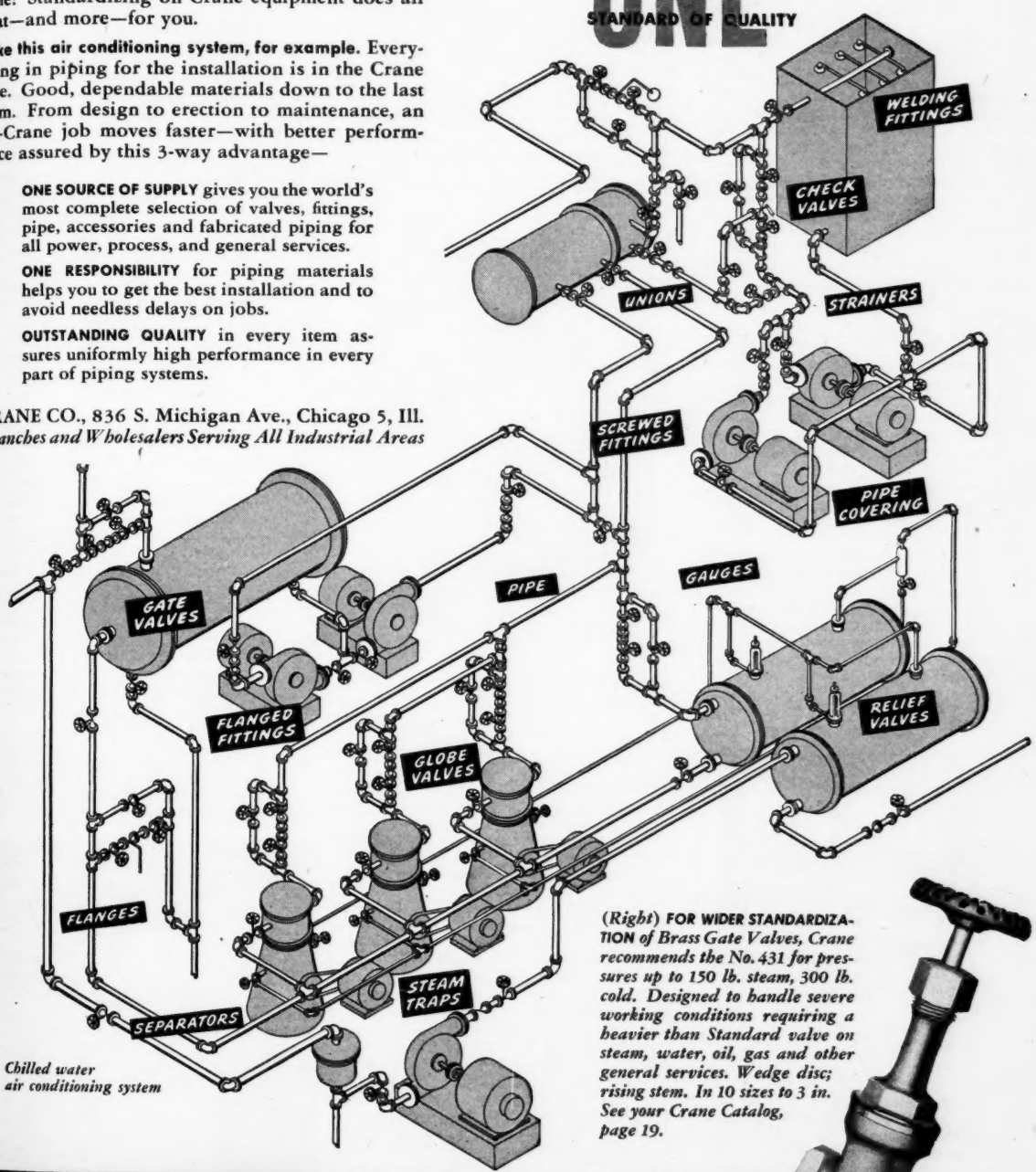
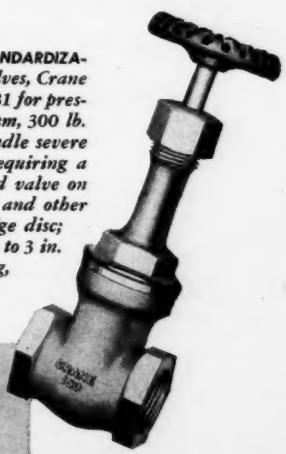


Chilled water air conditioning system

(*Right*) **FOR WIDER STANDARDIZATION** *of Brass Gate Valves, Crane recommends the No. 431 for pressures up to 150 lb. steam, 300 lb. cold. Designed to handle severe working conditions requiring a heavier than Standard valve on steam, water, oil, gas and other general services. Wedge disc; rising stem. In 10 sizes to 3 in. See your Crane Catalog, page 19.*



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PIPE • PLUMBING
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FOR EVERY PIPING SYSTEM

control is the new Dynalog Electronic Recording Pyrometer. This instrument has many revolutionary improvements on previous standard design. It has no galvanometer, no slide wire, no dry cell, and requires no standardizing. Because of the instrument's continuous balancing action, the recording pen can traverse the full width of the chart in one second's time. Sensitivity is $\frac{1}{10}$ of 1 per cent of the full scale range. For applications of temperature measurement, Dynalog instruments are available with ranges between —200 F and +2800 F, and for use with thermocouples or electric resistance bulbs. Recorders and recording controllers are offered. A giant indicating scale, for long-distance reading, is an optional additional feature.

A special reason for interest in the Dynalog all electronic instruments is their unusual versatility. In addition to temperature applications, they are also in use for the measurement or control of humidity, force, strain, pH, speed, and many other process variables.

K Electronic Pyrometric Controller

The new Veritron electronic pyrometric controller has just been announced by the Taco West Corp. This instrument is a two position electronic controller offering many unique features including a new electronic circuit, ultra compact design and simplified operation. It is specially suited for direct installation on industrial furnaces and plastic moulding machines.

In operation, the controller pointer is set at the desired temperature and control is immediately established within an exceptionally narrow temperature range. The design permits the instrument movement to operate a heavy duty relay system without any physical contact or reaction effect on the indicating

pointer. The relay is built in and has a load capacity of 3-kw non-inductive. The electronic circuit requires no tuning or other adjustments by the user at any time. This is accomplished without using high frequency oscillator systems, capacitance systems or mechanical clamping mechanisms.

The electronic control mechanism is absolutely stable (chatter free relay operation) unaffected by line voltage variation, surge effects, tube ageing or component changes. A pointer movement upon scale of 0.002 in. produces exacting relay operation.

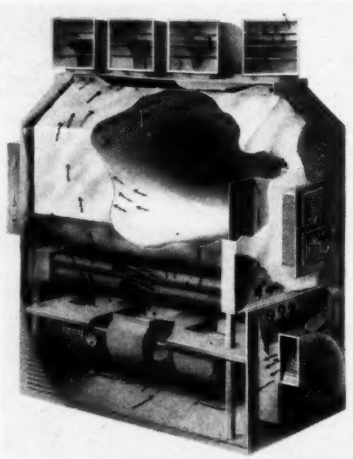
The measuring system is unusually well compensated for cold junction deviation, moving coil temperature coefficient, and magnetic errors. By a newly developed welding process all vital components of the measuring system are rigidly fastened to insure a mechanical alignment undisturbed by stresses and strains due to vibration, shock or ambient effects.

L Combustion Chamber

Development of a stainless steel combustion chamber for its commercial and industrial direct fired heater has just been announced by Dravo Corp.

By using this material for combustion chambers, Dravo engineers assert that the life expectancy of these heaters has been greatly increased since stainless steel has such high resistance to oxidation.

While stabilized stainless steel has



been used in high temperature work, such as ducts for direct fired turbines, this is believed to be the first time it has ever been incorporated in commercial and industrial space heaters. The vulnerable part of an air heater is the combustion chamber where oxidation from high temperatures may cause inefficiency and failure. The application of heat-resisting steel in the Counterflo Heater not only will prolong its useful life, but will aid in maintaining high efficiency.

Refractory lining, which has always been considered necessary with carbon steel chamber construction, is completely eliminated in the new type. As a result, it is lighter in weight and more compact in size, making possible a much wider range of application. For instance, suspended heaters may be located in the building roof trusses, either vertically or horizontally, depending on the head room.

In this type of heating, developed by Dravo, warm air is discharged horizontally over the floor above the workers' heads at a flow rate of about 2000 ft per minute. This enables wide floor areas to be covered without the use of ducts. The flow rate of the returning air, coming from all directions, is so low that there is no appreciable draft even a few feet from the heater.

Eight different sizes have been developed, ranging from 400,000 to 2,000,000 Btu per hour. All are of the same basic design and are completely equipped with modern safety devices.

M Circuit Breaker

The new Westinghouse Quicklag circuit breakers provide several new refinements, chief of which is a new tripping action which combines the inverse time limit characteristics of bimetal thermal action on overloads with the operating speed of magnetic trip action on short circuits.

Available in single or double pole, 10 to 50 amp, 125 to 125/250 v a-c, the new breaker provides another important improvement, a redesigned "Deion" arc chute that eliminates the need for a vent screen in the bottom, thereby permitting mounting flush to pan. This eliminates need for the $\frac{3}{8}$-in. mounting clearance formerly required. Other improvements include: a sturdier operating handle more enclosed than the old; internal design requires less handle movement; hole in handle permits more satisfactory method of attaching handle extension for two-pole operation; and smooth flush surface to eliminate dust traps.

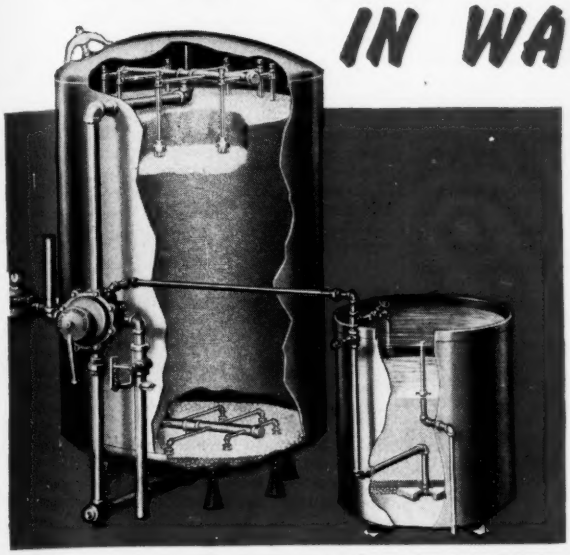
Of primary importance to circuit breaker users is the fact that the new Quicklag will not require retooling or redesigning existing fabricating facilities as the overall and mounting dimensions are the same as for the older Quicklag.

N Extinguisher for Electrical Fires

Featuring a streamlined "trigger" control for the quick release of its fire-killing yet non-conducting carbon dioxide gas, new portable fire extinguishers manufactured by Walter Kidde & Co., Inc., are finding extensive use throughout the nation's industries for safeguarding against fires of electrical origin. These easily handled bright red extinguishers can quickly be brought into action for the fast extinguishment of numerous types of fires involving delicate electrical equipment. The portable extinguishers are available in $2\frac{1}{2}$, 5, 10, 15, and 20 lb sizes, and wheeled units in 50, 75 and 100 lb sizes.

The modern trigger control valve installed on all portables, is the result of many years of engineering research in which certain objectives were sought;

WHO OFFERS MOST IN WATER SOFTENING?

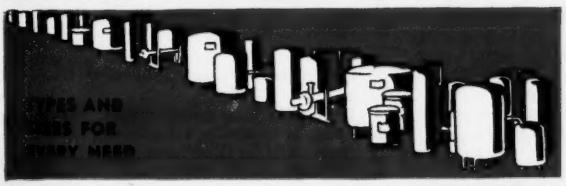


First consider these unmatched features of the Elgin Water Softener . . . . .

1. **Delivers up to 44% More Soft Water**—than other zeolite softeners of the same size.
2. **Lower first cost**—on basis of cost per thousand gallons delivered.
3. **Lower operating cost**—as a result of reduced salt and wash water consumption achieved by improved distributing and collecting arrangement.
4. **Higher efficiency**—because zeolite is kept clean and active, producing more zero-soft water per pound of salt used.
5. **Less Maintenance**—proved by surveys showing fewer repairs, less replacements, and prevention of zeolite loss.
6. **Longer life**—a result of more efficient distribution, collection and regulation of water and brine which keeps zeolite clean and adds years to service life.
7. **Less space required**—other softeners must be as much as 50% larger to give equal capacity.

—then consider Elgin nation wide service

In the opinion of hundreds of users, the features of the Elgin Zeolite Softener listed above make it the most effective equipment of this type ever developed. However, no single piece of equipment offers a solution to all water conditioning needs. Therefore, Elgin engineering service is as important as Elgin equipment. Elgin district engineers are located in principal cities from coast to coast. They are specialists with practical operating experience who will assist you in providing economical water conditioning engineered to your particular requirements.



—and the scope of Elgin equipment

With water softeners of every type and size from which to choose, Elgin is in a position to provide equipment specifically designed to your needs. Incredible though it may seem, Elgin is in a position to build over 5,000 combinations of types and sizes of water conditioning equipment.

—Above all, Elgin Experience . . . . .

At your service is knowledge gained in over 38 years of research and engineering experience in which Elgin has pioneered major improvements in the science of water softening and conditioning. In our research department alone, a large staff of engineers and chemists devote their entire time to the solution of special water problems. They maintain one of the country's most complete files of water analyses. Any new analytical work required in making recommendations is performed without charge.

Yes, from any standpoint — product, engineering service, experience — Elgin is the choice of leaders in every field.

NEW BULLETIN 607 gives all the facts. Ask for it.

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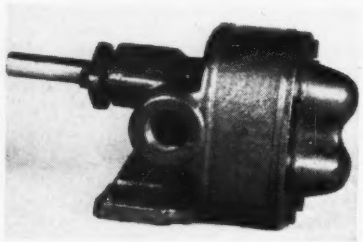
an on-and-off discharge control of carbon dioxide gas with a minimum of effort, a high rate of flow of gas, easy open-locking with one hand, and the incorporation of these features in a small compact unit, light in weight and simply designed. All these advantages have been accomplished in the new trigger valve. In addition two other safety features have been incorporated: a locking pin designed to prevent bending or jamming and an easily observed seal wire, placed where it is at least likely to be broken prematurely.

O General Service Rotary Pumps A new line of general service rotary pumps, the GA Rotary type, has been introduced by Worthington Pump and Machinery Corp. Six sizes are available in various mountings for capacities up to 51 gpm and 100 psi.

These small capacity rotary pumps have been designed for durability under severest service requirements, and adaptability to variety of such requirements offered by industries. Design features include four bearing construction



and special herringbone rotors. Built-in pressure lubrication eliminates all external lubrication and the danger, prevalent in many industries, of liquid contamination. A production line item, the GA Rotary in its simplicity of design also offers easy maintenance and low first cost.

Models are available footmounted or flange mounted with adjustable stuffing box and mechanical seal. They are also available with or without oversize unloader type relief valve. All models are suitable for direct coupling to electric motors of any make.

P Electronic Instruments Hays Corp's. Electronic Instruments have been under development for the past several years and are designed for oxygen, carbon dioxide and other acid gas determinations, temperature, pressure, absolute static or differential, fluid flow, liquid level, specific gravity of liquids, weighing, speed measurement, position and other similar factors.

In the Hays Electronic Instrument provision is made for one to four continuous line records on the same 12 in. chart regardless of the purpose for which the record may be used. The indicator and scale is a standard part of each instrument and is available, calibrated to read direct in any value of any one of the recorder functions for which the instrument may be used.

Internal fluorescent illumination is provided as standard so that both charts and indicator can be read at night and at a considerable distance.

The circuit used on the electronic instrument together with transmitter is a form of a resistant Wheatstone Bridge for use on alternating current. A separate amplifier and motor driven, balancing slide wire and cam assembly is used for each recording pen so that no switching device is required.

Two types of amplifiers are used depending upon the application and the amount of amplification necessary for accuracy. The amplifiers are mounted inside the case when not more than 3 high-gain amplifiers are used. By means of the cam characteristics of the function being measured such as the square root relationship between differential pressure and flow or other characteristics which are not linear, can be compensated for in the design of the cam so as to maintain a uniform chart and maximum accuracy.

The motor used for driving the slide wire and cam which positions the pen is of special design which prevents hunting or overshooting. The feed of the pen for full travel across the chart is 6 seconds for standard operation but may be increased or decreased if needed. Over 1 lb of torque is available to drive the pen.

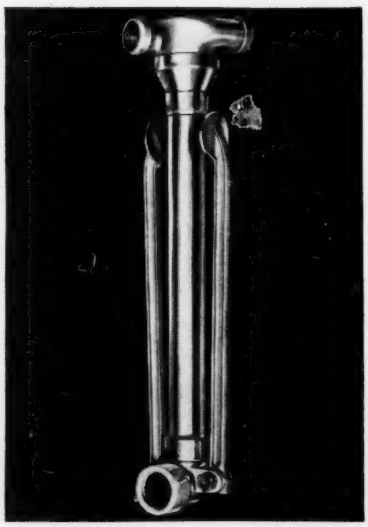
Each electronic unit is provided with a calibration box mounted on the back of the chart plate. In this box are assembled the necessary resistance for calibration of the recorder to the transmitter with which it is used. The calibration may be changed in the field by installing a different calibration box.

Unit construction has been adopted and each main assembly is held in place by a few screws and all electrical connections are made through multi-prong plugs which make it possible to incorrectly connect any assembly into the electrical circuit.

Automatic electronic control can be provided, one for each recording unit or any commercially available air operated control can be used.

Q Cellar Pipe for Fire Fighting Here is a new all aluminum-alloy Waterfog cellar pipe for fighting fires in ordinary combustibles and flammable liquids announced by Rockwood Sprinkler Co. Easy to handle in action, this unit is sturdy, compact, light weight and resistant to corrosion.

The nozzle is designed with arms that extend horizontally to prevent nozzle from dropping through hole prepared for it and also to steady the nozzle when in operation. These arms can be folded against the nozzle making a very compact unit. The nozzle itself is long enough to clear beams, joists and other obstructions, when inserted in a cellar or attic.

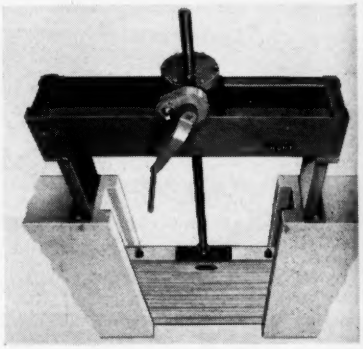


The head which discharges high velocity Waterfog rotates without leakage or friction on high quality precision thrust-bearings. When in operation, the head revolves in perfect dynamic balance in any position.

Available in 1½ in. and 2½ in. sizes for fire hose lines, the cellar pipe will operate effectively at pressures ranging upward from 30 psi.

R Self-Contained Gate Unit A simple, practical, easily installed arrangement of a wood gate and control has been announced. One of the big features of this new application of a Rodney Hunt Gate Hoist design is that installation time is cut to the minimum. There are said to be no costly shut-downs.

A positive, self-locking, easily operated control may be installed for either



hand or direct-connected electric operation.

Bench stands of many capacities lend themselves to ready installation on any of these units, as illustrated. Wood gates are designed for thrust loads imposed and can be furnished to suit your requirements.

S Voltage Regulators Regulated d-c voltages at currents and stabilities previously available only with batteries are now possible through a new line of voltage regulation units, called Nobatrons, which have been announced by Sorenson & Co., Inc.

Nobatrons, available in six standard models, operate on a 95-125 v a-c source of 50 to 60 cycles and provide amperages of 5, 10 or 15 with output voltages of 6, 12 or 28 respectively. Regulation accuracy of one half of one per cent, maximum ripple voltage (rms) of one per cent and recovery time of one fifth of a second make Nobatrons ideally suited for critical applications where constant, unvarying d-c voltages are required.

Among the more important uses for Notabrons are in d-c ammeter calibration in experimental, standardization and quality control laboratories, in photographic studios to replace batteries for furnishing power to light sources, in battery operated relays, in supplying current to filaments of d-c amplifiers

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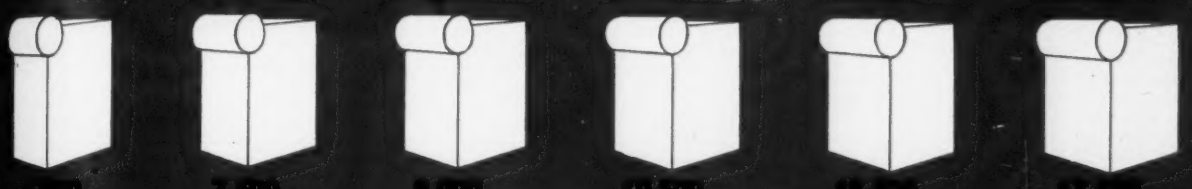
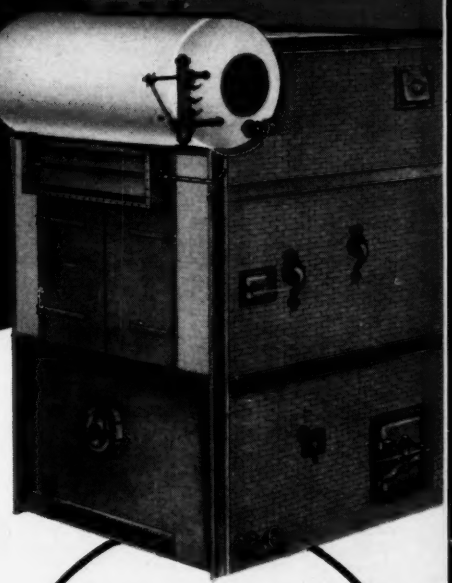
. . . to save you time and money



pounds of steam per hour (10 ft. tubes)

pounds of steam per hour (12 ft. tubes)

type "m"



● Springfield's new standardized line of Type M boilers makes it easy to meet small to medium size steam plant needs with minimum delay and less capital investment. Designed for high efficiency, automatic firing with oil or gas, Type M boilers incorporate numerous outstanding quality features: water-cooled furnace . . . electric cast steel headers . . . welded, x-rayed, stress-relieved drum . . . water-cooled sectional baffles. All dimensions are standardized — width varies with capacity. Twelve sizes to choose from All facts and figures available. Ask for complete information.

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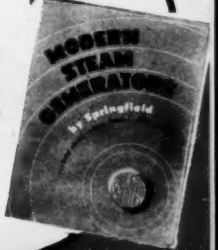
ask for a copy...

Ask for a copy of this bulletin containing "Facts You Should Know About Steam Generating Units."



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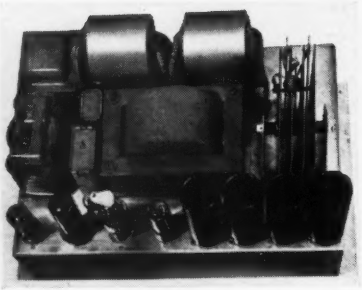
STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE
ANY FUEL
ANY PRESSURE

XUM



and in every other place where it is desirable to replace a battery to guarantee continuous regulated supply and to eliminate the difficulties of maintaining a power pack source.

Control features of the Nobatron line include an "on-off" switch, a voltage adjustment, a control circuit fuse and a pilot light. Models are available either for panel mounting or encased in a cabinet with gray wrinkle finish.

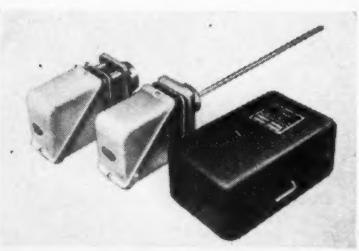
T Air Pressure Regulator A. Schrader's Son, Division of Scovill Manufacturing Co., Inc., announces the introduction of a new air regulator.

The new regulator is adjustable to function in systems operating at pressures from 150 to 10 psi. Many of these regulators can be used in a system, one for each tool or air-operated machine, because they quickly pay for themselves.

When an air tool is designed to operate at say 100 psi and the line pressure is 150 psi, the difference in pressure is ordinarily wasted. With the regulator, air to any working part used in conjunction with air cylinders, machine controls, etc., is delivered at the pressure for which the regulator is set (always less than lowest line pressure), saving wear and tear on the compressor and reducing air costs.

Another important purpose of the regulator is to keep the pressure at the equipment constant regardless of the sometimes wide variation in the system pressure.

U Flame Failure Safeguard To protect against the hazard of explosion caused by flame failure in industrial oil burner installations, Combustion Control Corp. announces a new Fireye Photoelectric Flame Failure Safeguard. The instant flame fails, fumes and gases accumulate and combine with air to form a dangerous highly explosive mixture within the combustion chamber. When this condition occurs, control time is vital. Fireye Flame Failure Safeguard provides for complete protection against this danger. Fireye photoelectrically "sees" that the flame has failed and instantly turns off the fuel supply and the burner.



The equipment consists of Photoelectric Scanner Type 45PH5 for monitoring the main oil burner flame and Programming Control Type 24PJ8 for programming the oil pump, oil valve, and ignition system. Flame Rod Type 45JP1 may be added to this combination if it is desired to monitor the gas pilot flame as well.

The above equipment is recommended for the control of all fully automatic oil burner installations.

The photoelectric scanner is exceedingly compact in design and readily installed on the burner plate either at the time of assembly of the original burner equipment or upon installation in the field. Since the scanner contains both the phototube and amplifier tube, no special shielded cable is required between the scanner and programming control. The photoelectric system is designed to withstand conditions of relatively high ambient temperature and is impervious to ambient humidity. It represents the last word in electronic design and embodies safe failure features hitherto unavailable.

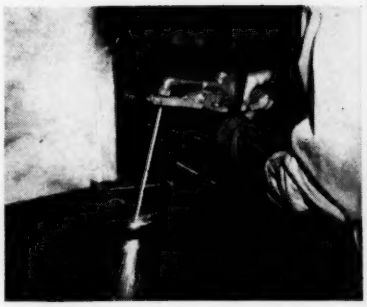
The programming control is designed to provide accurate setting of both oil valve delay and post ignition periods in seconds upon installation. Timing is accomplished through a synchronous motor. Relay contacts are of heavy duty type capable of handling directly a pump motor of 1 horsepower rating. The relay contacts are in an accessible location.

V Sludge Solvent The result of extensive laboratory research and field experiments, O'B-Oil, a new product of O'Brien Industries. Brings under control the gums, resins, sludge and water emulsions which accumulate in fuel and Diesel oils during transportation and storage. The treatment is so successful that its use in both marine and industrial plants is rapidly increasing.

The O'B-Oil is a properly balanced compound of high-grade ingredients, some being developed by O'Brien research. It consists of a wetting agent for efficient dispersion, alcohol for water separation, a chlorinated solvent and an aromatic solvent. The formula includes only active ingredients; it contains no diluents. Flash and fire points are high enough so that O'B-Oil is classified as non-inflammable yet all ingredients are combustible when fed to burners in fuel oil. Important also is the fact that O'B-Oil will not corrode tanks or equipment when mixed with fuel oil; it contains no caustic soda.

W Cutting Alloy Steels Arcos Corp. has developed a new method for hand cutting or piercing stainless and stainless clad, alloy steel, aluminum, bronzes and brasses, cast iron, Monel, Inconel and nickel. The process—known as the Arcos Oxyarc Process—achieves the cutting by the combination of an electric arc and a stream of oxygen.

The equipment consists of a specially designed Arcos Oxyarc holder, and a tubular coated Oxycuttend rod which is consumed in the process of cutting. The process can be used wherever an a-c or d-c welder and bottled oxygen are available. The "knack" or cutting with Oxycuttend can be acquired in less than an hour's time.



Because the Oxyarc Process will cut or pierce any metal, in any shape, and in any position, it can be used to great advantage in a wide variety of metal cutting operations. The equipment used in the Oxyarc Process is low cost and represents one of the most versatile and effective hand tools ever devised for cutting metals—particularly stainless and non-ferrous metals.

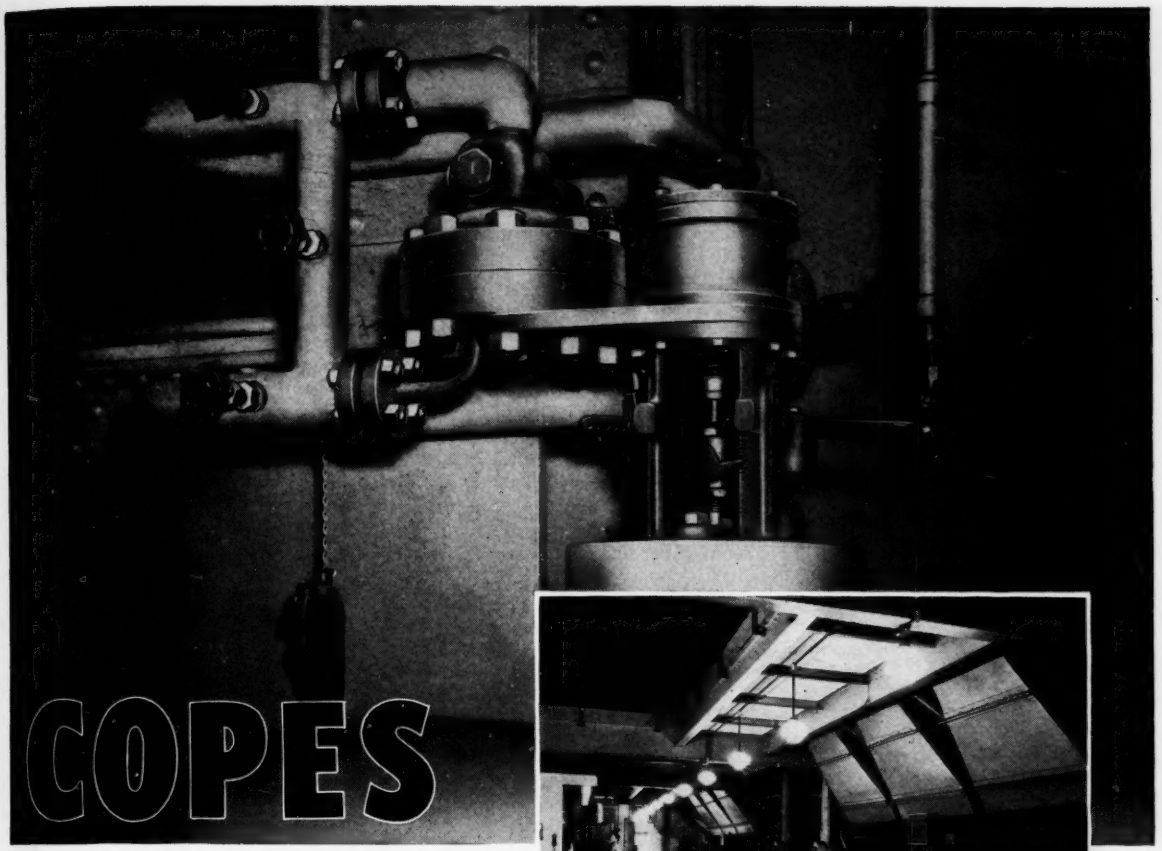
X Steam Traps This new steam trap is designed for installation where uniform, accurately controlled temperatures and pressure of dry steam in equipment and processes are necessary. The trap provides steady, continuous flow of condensate without chatter, vibration, intermittent discharge and steam loss. The outlet valve is described as self-sealing, being operated continuously by the condensate and not intermittently by the steam. The sliding valve mechanism automatically compensates for wear; it continuously frees the valve orifice of sludge or other foreign matter in the line by its cutting action in a vertical plane against the orifice. These traps are made in screwed and flanged types in ½, ¾ and 1 in. pipe sizes for nominal pressures of 150 psi and 300 psi and temperatures to 750 F. They are announced by W. S. Rockwell Co.

Y Control For Pulverizer Feeds An Improvement that makes electronic regulation of pulverizer feeds more dependable than ever has been announced by Mosher Electronic Controls.

Electronic regulation of pulverizer feeds has raised output of the average mill 20-35 per cent. Many new model grinders feature electronic controls as standard equipment.

Amplified signal is the latest advance in coordinating feeds to maximum grinder motor load. This new principle does away with mechanical adjustment of critical relays. Electrically regulated vacuum tubes are reported to replace such mechanical adjustment and eliminate moving parts. While sensitive to all changes in rate of feed to the grinder, the new type controls are not affected by fluctuations in power line voltage. Because of a new gasketed control box, dust and other foreign matter cannot readily enter to disturb accurate operation of the instrument.

Among the advantages claimed are less wear and tear on the instrument, more uniform pulverizer output, less manual supervision—all resulting in lower operating costs.



COPES

at Jennison Station

means close boiler water level control by COPES Flowmatic on two 675-psi, 825-F Combustion Engineering two-drum steam generators, each rated at 200,000 pounds of steam per hour, largest units in this country stoker-fired with anthracite.

JENNISON STATION, most modern steam plant of New York State Electric & Gas Corporation, is benefitting from close boiler water level stabilization, provided by two-element COPES Flowmatic. Adjusted to carry a higher level on heavy loads than on light, total variation is within plus-or-minus one inch. The story is told in Bulletin 463—Boiler Feed Control at Westover, Greenidge and Jennison Stations. Write—your letterhead, please—for a copy.

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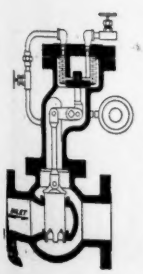

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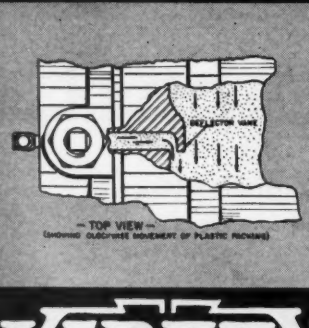
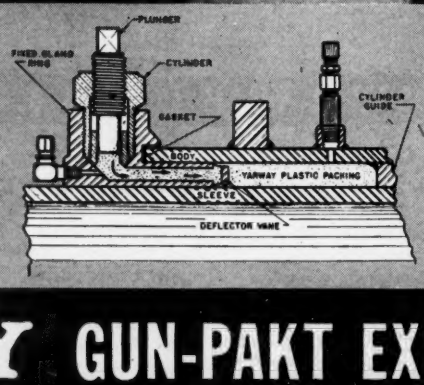
Maintenance man servicing a typical Yarway Gun-Pakt Joint





Double and flanged-type Yarway All-Steel Gun-Pakt Joint, 300 lbs. pressure.

YARWAY GUN-PAKT EXPANSION JOINT

WHAT LEADERS SAY

How to Beat the 40-Year Deadline

By H. A. WAGNER

ALL TECHNICAL and professional societies must cooperate in a campaign to alleviate or dispel the general prejudice against hiring men over 40. We must show that the prejudice is based on dangerous and unfounded generalities, amounting to fallacies concerning the effect of age on technically trained men's efficiency. This effort on the part of the societies, even though vigorous, concerted and convincing in its logic, will not suffice to insure congenial and appropriately compensated employment for every man over 40. It cannot be accomplished by dispensation from on high. Too much depends on the individual who is past 40.

There are relatively few "permanent" jobs in engineering. Definite projects are completed, and the technical men who do the work move on to other assignments in the same organization or to new enterprises. Fluctuation in the market for a particular product or service causes retraction in the technical staff and sends professional workers out in search of new employment. To be sure of satisfactory employment after 40, a wise engineer begins to hedge against the 40-year deadline before he is 30.

In his salad days it may be wise to be a rolling stone—at least until he has discovered his own aptitude for or supreme interest in a special branch of engineering, and has developed proficiency in that line. Most engineers will find it advantageous to seek a connection with a firm or corporation in which they can capitalize on their ability and experience and which offers them an opportunity for advancement—one in which they can become indispensable employees, who with reasonable certainty can expect to maintain a connection with the organization until retirement.

This, however, is not enough to guarantee satisfactory employment after 40. Just being "Old Dog Tray" will not with absolute certainty underwrite the future. Depressions, wars, technological innovations, a dozen unpredictable developments, may upset job-security plans that depend wholly on attachment to a single business organization. Fundamentally, a man's fate after 40 depends on the qualities he has preserved, developed or overcome in the preceding 15 years of practice.

Certain qualities generally ascribed to youth, are not really the exclusive property of young men. Energy, initiative, elasticity, pliability, daring adaptability can be characteristics of the man past 40, if he quite purposefully retains these qualities; and their value can be enhanced if they are intelligently tempered. Not all youths have these virtues—rigidity can set in at 25 or 30 as well as at 40. Nor are all these attributes unalloyed assets—too much initiative, too much daring, not governed by discretion and judgment, can be disturbing rather than constructive forces. The average engineer should watch himself for any sign that he is becoming unduly "set in his ways," reluctant to consider any except the "one way" of doing a particular thing, afraid to try new and untested materials or procedures. Obviously, an alliance of societies, no matter how many or distinguished, is unable to provide insurance to the individual against "ossification."

To keep the right attitude toward work, toward employers and fellow employees, an engineer must cultivate friends. He needs the practice in give-and-take, the sympathetic understanding, the invigoration, the susceptibility to new ideas which can be engendered or enhanced by "play"—by social intercourse. He needs hobbies and congenial confederates to participate in their pursuit. He needs the wit-sharpening encounters provided by bull-sessions that follow technical and professional society meetings and conventions and dinners. Engineers are too prone to follow "lone wolf" hobbies, if they have hobbies at all; to beg off from social affairs in which they might get valuable insight into the non-technical aspects of their work, its broader significance. Most of all, they shun civic and political activities—shirking all responsibility in work that might increase their stature as men and help them retain the qualities that enhance value after 40.

In civic and political organizations, in the committe work of such agencies as our Chicago Technical Societies Council, these men can develop leadership qualities, broaden their understanding of the part that technology plays in the life of people, perfect their "human relations" and retain the qualities which make them valuable as young employees but too often evaporate before they are 40.

There is another argument in favor of camaraderie and cooperation that evolves from participation in organized activities. This advantage is summed up in the word "contacts." When an engineer is out of a job, he knows the value of "contacts." If he has worked with a host of men connected with many varieties of enterprise such as Chicago Technical Societies Council, it is easier to learn of openings. It is also much easier to win one of the jobs if he has the enthusiastic backing of a number of leading citizens who know his general as well as his professional virtues.

Participation in society affairs and in the work of civic and political organizations tends to promote another quality which has more influence than most engineers ascribe to it. This is the highly personal qualification of "appearance and bearing." Too many engineers approaching or past 40 have allowed themselves to grow careless of clothes and grooming, sloppy in pos-

(Continued on page 138)

H. A. Wagner is a consulting mining and metallurgical engineer with headquarters in Chicago. He has been very active in various movements for enhancing the professional status of the engineer and promoting the unity of the profession. For example, he was a national director of American Association of Engineers from 1925 to 1932, has been its president and is now chairman of its National Employment Committee. He is also a co-author of the book The Technologists' Stake in the Wagner Act, now recognized to be one of the few authoritative discussions of the National Labor Relations Act in operation as it affects engineers, chemists and architects.

Mr. Wagner was born in Grahamtown, New Zealand, received his degree of EM at Freiberg University in 1888, his PhD at University of Heidelberg in 1889. He then became metallurgist of Dowlais Steel & Iron Co. in Wales. From 1890 to 1899 he was manager for Barnato Bros. in South Africa; 1901 to 1904, mining engineer for F. A. Heintze in Butte, Mont.; 1904 to 1907, mining engineer for Globe Exploration Co. of London; since 1907 has conducted his own consulting business.

He is inventor of numerous electrolytic and flotation processes for treatment of ores and metals. He has written many technical articles and discussions of engineers' salaries, status and vocational guidance problems. He is president and treasurer of Mayer Ore Purchasing Co., president of Wagner Metal Co.; member AIM&ME, AAE, AIEE, ASEE, American Electrochemical Society and others; was awarded the Clausen Gold Medal in 1932 for services rendered in the betterment of the engineering profession.

The above comments are reproduced from Mr. Wagner's recent article in the *Sci-en-tech News*, published by the Chicago Technical Societies Council.

Efficient Electric Elevator Maintenance Pays Dividends

By THOMAS TRAIL

MODERN installations of electric elevators represent substantial investments running into many thousands of dollars. Efficient and successful cost control systems take into consideration the fact that such major investments must be protected, by providing for their adequate maintenance and upkeep in estimates of yearly budgeting. This is intelligent practice because nowhere else can deterioration occur so rapidly as in machinery that does not receive proper periodic care and attention. Because elevator installations usually represent a very large proportion of the total machinery in hotels, stores and office buildings, it is especially important that these be given particular attention.

From the point of view of public service and satisfaction, it is more important that the elevators always function properly than any other equipment in the building. Breakdowns of elevators are directly communicated to the occupants and visitors to the building, whereas a failure of other machinery might well go unnoticed. Furthermore, the reputation for service of an establishment can be greatly affected by the efficient, dependable service or lack of it, rendered by its elevators.

The only sound plan for elevator maintenance is one in which all factors are covered. An elevator is a complicated electrical machine that is subject to wear and general deterioration. The wear can be minimized by proper and intelligent lubrication. The deterioration can be kept within reasonable limits by maintaining each part in the best possible condition. Progressive wear and deterioration will quickly take their tolls if neglect is practiced. Therefore, a simple but complete system of periodic attention and preventive maintenance must be set up. This can best be done by establishing definite schedules. A schedule of lubrication can be worked out and a chart made (See Fig. 1) on which are entered the date and by whom each lubrication task is performed. On this chart are entered all the bearings and bearing surfaces requiring lubrication, as well as the frequency of lubrication and the type lubricant to use. Any unusual conditions of individual bearings or locations can be noted on the chart also, to serve as a guide.

A similar chart (See Fig. 2) can be set up for electrical maintenance and one for mechanical maintenance. Of course, on small elevator installations all three types of maintenance can be included on one chart, laid off in sections.

Periodic Servicing Important

A good practice to follow, where possible, is to take each elevator out of service periodically and give it a complete examination. This includes examining all bearings, contactors and relays, motor-generator set, brake, signal equipment and any other apparatus in or around the penthouse having to do with the operation of that particular elevator. During this inspection the hoisting and compensating cables should be checked, as well as the governor cable (Fig. 3) for excessive wear, oiliness or dryness. The control cables should also be examined for fraying and loose support fastenings. The cable sheaves in the bottom of the shaftway and on the secondary level at the top of the shaftway should receive attention. The mechanical and electrical operation of the governor and governor switch, the slack cable switch, emergency car stopping switch, overspeed switch, emergency overtravel limit switches and any other safety devices with which the elevator is equipped, including the car safety shoes and cable under the car, should

THE AUTHOR SAYS:

I was first employed in 1928, at the age of 17, by the Lord Baltimore Hotel in Baltimore, Maryland as a maintenance mechanic. Soon afterwards I was made electrician's helper, which job I continued in until 1938 when I became electrician. I held this position until late in 1946 when I resigned to take up full-time writing for technical and trade publications. During my employment with the Lord Baltimore Hotel, I had devoted spare time for a number of years to such writing.

Since, like all large hotels, the Lord Baltimore contained a great variety of electrical and mechanical equipment, I had ample opportunity to gain a wide experience in maintenance work on almost every type of equipment from kitchen electric fruit juice extractors and gas and electric bread toasters to modern high speed, self-landing passenger elevators. This experience has been very useful, both in enabling me to write directly from experience and to be able to comprehend and interpret further developments in these and allied fields.

LUBRICATION CH

ELEVATOR NUMBER		№1 OIL HOIST MACHINE MONTHLY	№2 OIL M-G SET WEEKLY	№1 OIL SECONDARY SHEAVE WEEKLY	GREASE GOV. SHEAVES WEEKLY	GREASE COMP. SHEAVE WEEKLY	№2 OIL CAR AND SLOWDOWN SWITCHES MONTHLY	№2 OIL CAR SAFETY MONTHLY	№3 OIL GUIDE RAILS WEEKLY	№2 OIL CAR GATE WEEKLY	GREA SHAFTWAY
1	DATE	3-6-46	3-6-46	3-6-46	3-6-46	3-6-46	3-6-46	3-6-46	3-6-46	3-6-46	3-6-
	MECHANIC	R.J.	R.J.	R.J.	R.J.	R.J.	R.J.	R.J.	R.J.	R.J.	R.J.
2	DATE	3-7-46	3-7-46	3-7-46	3-7-46	3-7-46	3-7-46	3-7-46	3-7-46	3-7-46	3-7-
	MECHANIC	S.T.	S.T.	S.T.	S.T.	S.T.	S.T.	S.T.	S.T.	S.T.	S.T.
3	DATE										
	MECHANIC										
4	DATE										
	MECHANIC										
5	DATE										
	MECHANIC										
6	DATE										

Fig. 1. A lubrication chart will tell the mechanic when, which and with what to lubricate and also tells the supervisor who did it

Lubrication, mechanical and electrical maintenance schedule charts should be employed . . . When possible, take elevators out of service periodically and give them complete check-up . . . Make no compromise with less-than-perfect operation, it's not worth it . . . Types of lubricants for various lubrication points are enumerated . . . Inspection and smoothing of contacts . . . Proper operation of brakes should be checked by operating car . . . Explanation of proper care of hoist machine; grinding new brushes . . Outline of good practice for examining hoisting, compensating and governor cables . . . Cleaning and lubrication of guide rails . . . Elevator company mechanic should be called in once a year for complete tune-up . . . Stock of parts should be kept and inventory chart employed for running inventory

be checked and tried, to see that all parts are free and in good working order, and that they properly perform the functions for which they are intended.

Car and Control Panel

The elevator car and its control panel should also be examined at this time. Any loose braces or other parts on the car should be tightened and all safety exit fastenings should be tried, as well as the exit doors or panels themselves, to make certain that they are in easy working order to serve in an emergency. The operation of the signal system should be checked in both directions at every floor, and it should be noted whether all functions of the system operate as they should at each floor. The car and counterweight buffers should be examined for correct liquid level and operation of parts. The guide rails should be checked for proper lubrication and for rigidness. Any loose clips or fastenings in the shaftway should be tightened. Slow down switches, guide rail lubricators, hoisting cable equalizers, roof switches and lights, and any other apparatus located on top of the car or in the shaftway should be inspected. This includes the covers of door tracks, dial indicators and wire junction boxes, which sometimes loosen. Do not overlook the car gate or door safety switch, and the operating motor if one is provided. The operation of the doors, hangers, guides, safeties, closers (or openers and closers) and the door safety switch should be checked at each floor landing. It is important that door safety switches be properly adjusted to open at the required point of door travel.

The operation of the car should be carefully observed to determine whether any unusual operating condition exists. It should start promptly and accelerate and decelerate smoothly, and if of an automatic-leveling or self-landing type, it should come to rest within the prescribed distance of the floor without excessive jar. Rail noises should be noted if they exist, as well as any excessive looseness or other indication of wear in the car guide shoes. Every detail of the elevator's operation should be critically noted and no compromise should be made. If it is not functioning at its best a note of this fact should be made.

In conducting the complete examination of the elevator, much time can be saved and maintenance efficiency promoted if the necessary tools and supplies to make repairs and adjustments are carried along. A small platform on rubber tired casters (Fig. 4) will be found very helpful. On it can be carried tools, supplies, lubricants and wiping cloths, and in this way they can be easily and quickly moved from one elevator to another.

Such a general inspection as this should be conducted at intervals depending on the age of the equipment and the severity of service. Naturally a new installation will not require as frequent checkups as one many years old. However, even new elevators should not be neglected if their modern efficiency is to be maintained. In general, elevators in heavy traffic service, such as in office buildings, hotels, department stores, warehouses, etc., should be given such a complete checkup once a month. Elevators in lighter service may go for two months between general inspections.

One important maintenance detail that should be taken care of at each general inspection is cleaning. Accumulations of dust and lint should be blown from all machinery, motors and generators, control panels (both front and back of boards), and the slowdown switch and car switch or controller on the elevator car. Be sure to carefully wipe off the surfaces of all contacts afterwards to be sure there is no dust or grease left on them. In cleaning dust out of equipment on the car be careful to avoid getting grit on the smooth surfaces of the elevator guide rails. Grit will easily stick to these lubricated surfaces, and even a very small quantity will cause annoying grinding noises and will cut the polished steel rails.

Dirt, dust and rubbish should be cleaned from all parts of the shaftway where it may be found. Bits of rubbish can cause faulty shaftway door operation and may find their way into electrical contacts.

Lubrication Most Important

Probably the most important single maintenance detail is that of lubrication. The high speeds and heavy loads to which elevator machinery is subjected make it imperative that bearings be adequately and properly lubricated. Neglect of this highly important matter may quickly result in irreparable damage to bearings. The labor and cost of replacing a bearing will equal a long period of proper lubrication care, besides causing unnecessary shutdown of service.

The lubrication recommendations of the elevator manufacturer should be followed to insure satisfactory bearing service. Where this information is not

ELE

ELEVATOR NUMBER		HOIST MACHINE	M-G SET	GOVERNOR SWITCH
1	DATE	4-2-46	4-2-46	4-2-46
	MECHANIC	C. S.	C. S.	C. S.
2	DATE	4-2-46	4-2-46	4-2-46
	MECHANIC	C. S.	C. S.	C. S.
3	DATE	4-2-46	4-2-46	4-2-46
	MECHANIC	C. S.	C. S.	C. S.
4	DATE			
	MECHANIC			
5	DATE			

MEC

ELEVATOR NUMBER		HOIST MACHINE	M-G SET	SECONDARY SHEAVE
1	DATE	4-8-46	4-8-46	4-8-46
	MECHANIC	J-H	J-H	J-H
2	DATE	4-8-46	4-8-46	4-8-46
	MECHANIC	J-H	J-H	J-H
3	DATE			
	MECHANIC			
4	DATE			
	MECHANIC			
5	DATE			

Fig. 2. Electrical and mechanical maintenance charts are constant reminders and also provide history of maintenance for every element in the elevator system

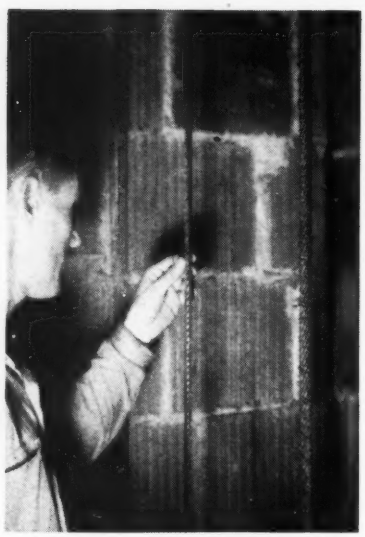


Fig. 3. Governor and other cables should be frequently and carefully examined

at hand, efforts should be made to obtain it. Failing this, such information may be obtained from a reliable lubricant manufacturer. In general, a heavy grade of motor bearing oil is used in pedestal bearings of hoist machines and secondary sheave bearings, over which the hoisting cables pass. This lubricant is also usually used in car shoe and counterweight shoe wick type guide rail lubricators.

Light grade motor bearing oil is used in ring- and wick-oiled bearings on motors and generators, and in most other equipment bearings not designed for grease lubrication. There are many frictional bearing points on elevator equipment and control apparatus where a drop of light oil periodically will insure smoothness and surety of operation. Some of these are: the car switch spindle and contact hinges, slowdown switch spindle and contact hinges, gate and door rollers, safety shoe operating shaft, control board contactor hinges, brake contact hinges, brake hinge pins, etc.

Most ball and roller bearings are designed for grease lubrication, though some are lubricated with oil. It is very important to remember that too much lubricant in a bearing is almost as detrimental as not enough. This is especially true of ball and roller bearings. These bearings should never be more than half full; one-third full is better. An excessive quantity of grease in such a bearing will create pressure and friction, resulting in overheating and escape of lubricant past the seals. It can also create resistance to the rotation of the ball or roller cage. This will result in flat spots on the balls or rollers and consequently a noisy bearing.

Grease is also used on certain plain bearings on elevator machinery, including governor cable sheaves, compensating cable sheaves, brake hinge pins, etc.

When inspecting automatic grease cups note whether the oil has squeezed out of the grease beneath the plunger, leaving a hard, solid residue. If so, it is advisable to try other greases until one is found that will retain its softness and lubricating qualities. If the grease finds its way past the plunger it indicates that a new leather cup is needed for the plunger, or the old one may be made to do by removing the plunger from the grease cup and spreading the leather cup to provide a tighter fit.

Wherever possible, pressure type grease fittings should be substituted for other than automatic means. These require less room, can be replenished more quickly and can be wiped free of dust and grit with greater ease.

Be sure to check the operation of ring and chain oilers on bearings (Fig. 5) so equipped to make certain they are functioning properly. No matter how perfectly the lubricant level is maintained, a bearing will soon be damaged if the ring or chain sticks and the shaft receives no oil.

Once a year all chain, ring- and wick-oiled bearings should be drained, flushed with light oil to remove accumulated grit and sediment and refilled with the proper grade of lubricant. Wicks should be removed before cleaning the bearing housings and soaked in a container of light oil to remove grit. Grease lubricated ball and roller bearings should be purged of old hard grease by forcing it out with new grease. Then the bearing housing should be left only ⅓ to ½ full of new lubricant.

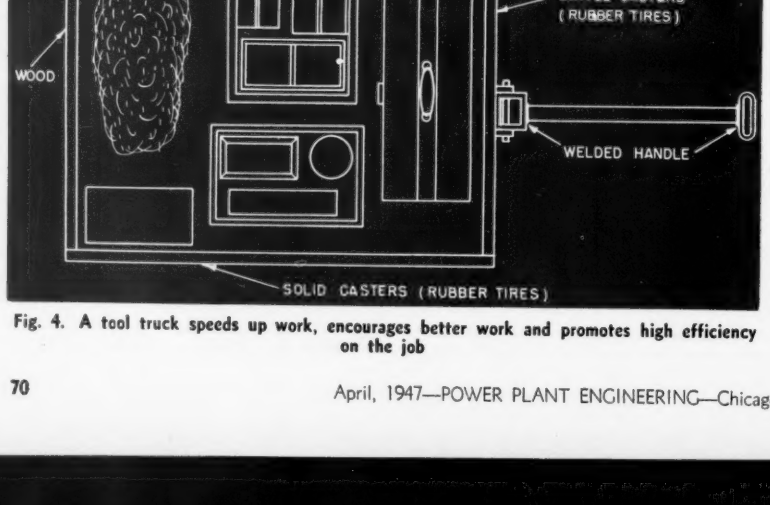


Fig. 4. A tool truck speeds up work, encourages better work and promotes high efficiency on the job

Inspection of Contacts

All contacts should be checked at the general inspection and any that are burned should be smoothed with a file, sandpaper or abrasive cloth. Be sure to remove any abrasive material from the contact surfaces after smoothing. If the contacts are badly burned away they should be replaced with new ones. Don't file or sandpaper contacts more than necessary, especially silver contacts, as this wastes the material needlessly.

Flexible shunts should be inspected for signs of broken strands. In general, if more than one-quarter of the strands are broken the shunt should be removed and a new one installed. A broken shunt can cause the shut-down of an elevator at a very inopportune time.

Check Brakes by Operation

At this time the brake should also be inspected. While the car is being operated for the purpose of checking the brake operation, observe the opening and closing action of the brake. The plunger should operate quickly on opening and closing. Brakes on gearless machines and brakes equipped with means to soften their closing stroke are exceptions. These brakes are designed to close quickly until just before the end of the closing stroke, when a means is introduced to soften their braking action slightly and thus prevent harsh stops. Brakes should always operate with a minimum of drum clearance. This will provide the smoothest stops. The brake closing springs should always be kept adjusted to hold 20 per cent more load than the full load rating of the elevator. To check this, the car should be loaded with test weights equal to the full load rating plus 20 per cent or ⅕ more weight. The car should be at a floor near the bottom of the shaftway, preferably the lowest landing. This is a safety measure in case the brake should fail to stop or hold the car. The car should then be run up one floor and the brake operation noted. The brake setting should be such as to hold the car steady and prevent any tendency to drift backwards on a stop in the up direction under test load. Similarly, on a down run the brake should stop the car quickly and smoothly without any tendency to drift below the floor in excess of prescribed limits.

Adjusting Brake Shoe Clearance

If the brake spring tension setting has not been altered since its test under load, do not change it. To adjust the brake for close running clearance, thus compensating for normal brake lining wear, adjust only the shoe clearance, not the spring tension. The correct shoe clearance should be such as to merely warm the brake drum slightly after several hours of normal elevator operation. If the drum remains cold, adjust the shoes closer; if the drum heats up move them slightly farther away. These adjustments should consist of only a frac-

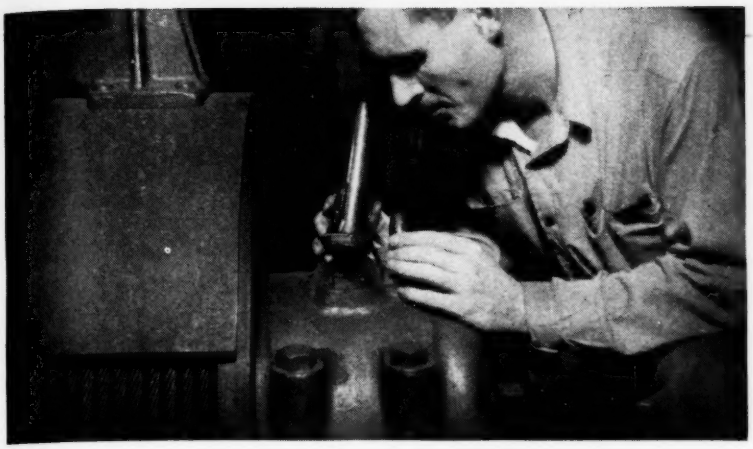


Fig. 5. Check bearing oiling devices frequently

tion of a turn of the adjusting screw or nut at a time.

Care and Inspection of Hoist Machine

During general inspection carefully examine the brushes and commutator of the hoist machine. If the elevator is equipped with a motor-generator set, check the brushes and commutators of this. If the motor-generator set is powered with an a.c. squirrel cage motor the motor will, of course, have no commutator or brushes. At this time also check the brushes and commutators of any other motors that constitute part of the elevator or its operation or control equipment, including signals. See that brushes are long enough to last at least until next inspection. If there is any doubt of this, replace them with new brushes. Grind all new brushes carefully to fit the contour of the commutator or slip rings. This is best done (Fig. 6) by passing a strip of sandpaper or abrasive cloth between the face of the brush and the commutator in the direction of rotation of the commutator, with the abrasive side towards the brush face. Use a fairly coarse abrasive at first, then finish with very fine abrasive to give it a smooth surface. Pressure should be applied to the top of the brush while sandpapering in order to make the abrasive cut faster.

Make certain that all brushes are free in their holders but not too loose. Remove each brush from its holder and clean any dust from its surface and that of the holder with a dry cloth. If any deposits of grease or oily dust exist, remove them with a cloth moistened with carbon-tetrachloride.

Cleaning, Sanding Commutator

Clean any accumulations of dust or oil and grease from the slots and bars of the commutator. This is best accomplished by first scraping out the slots with a sharp pointed stick, knife blade or hack saw blade. Then finish cleaning with a cloth moistened or saturated with carbon-tetrachloride. The commutator should then be allowed to dry thoroughly before running the machine. If the metal of the copper commutator bars has worn sufficiently to have dragged an edge over the slots, this should be removed with a sharp knife blade or similar tool (See Fig. 7). Afterwards lightly sandpaper or stone

APPLY PRESSURE ON BRUSH ONLY WHEN SANDING IN DIRECTION OF COMMUTATOR ROTATION (EXCEPT ON HOIST MACHINES)
SAND PAPER OR ABRASIVE PAPER OR CLOTH (NEVER USE EMERY)
COMMUTATOR

Fig. 6. Proper method of sanding-in brushes on commutator

the commutator surface with fine abrasive, while the machine is running, to remove the rough edges turned up on the bars by the knife.

Cable Examinations

When examining the hoisting, compensating and governor cables it is good practice to concentrate chiefly on the approximate sections of the cables that pass over the sheaves more frequently. For instance, in a building where the elevators often make short trips from the first floor part way up the shaftway and back to the first floor again during light traffic periods, it is natural that the parts of the cables that are on the sheaves when the car is at the first floor are likely to show the most wear, since the car always returns to this floor though it may travel to different upper floors on its various trips. However, each foot of the cables should also be examined carefully to guard against wear due to unusual causes or to defects in material. When any breaks in the wires show, those cables should be watched. In general, it is usually considered safe practice to discard a cable that shows several wire breaks in the same strand of cable within any 12 in. length of the cable. Since a cable whose wires have begun to show breaks is uncertain, it is neither safe, sensible nor economical to continue it in service until the last possible mile of service has been obtained from it. Such cables are unpredictable. Should such a cable suddenly break while in service, the danger of damage to equipment in the shaftway, to say nothing of the chance for causing injury and panic to customers, tenants, guests or employees, should certainly overweigh the slight monetary saving gained by keeping it in service. Of course, where municipal or insurance company inspectors regularly examine the elevator cables, their advice should be heeded regarding replacements. But they will not complain if you take an even more critical attitude toward safety and decide to replace worn cables before they condemn them.

Municipal Inspection

It is usual practice in larger cities to inspect elevators once every three months. This is done by municipal inspectors, or insurance company inspectors under the jurisdiction of the municipality. However, this schedule of

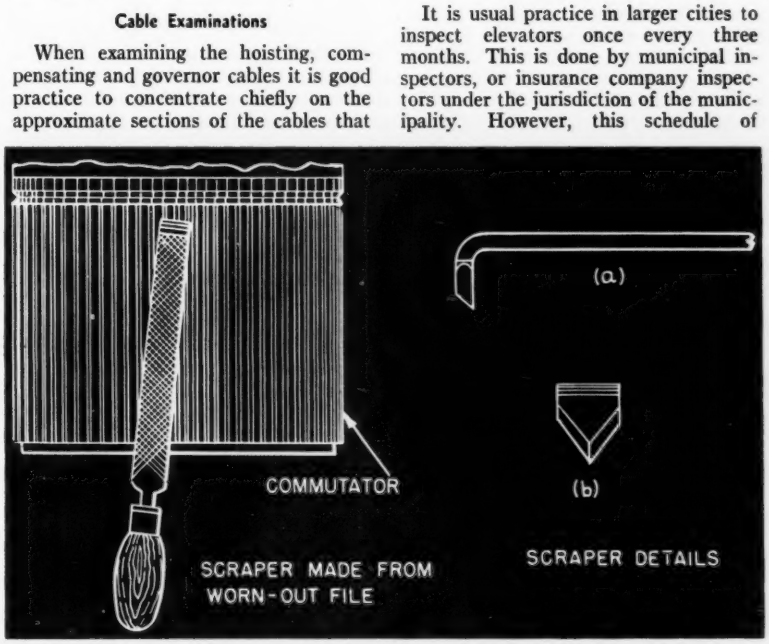


Fig. 7. This sketch shows method of removing worn copper from commutator bar edges and also the tools for the job

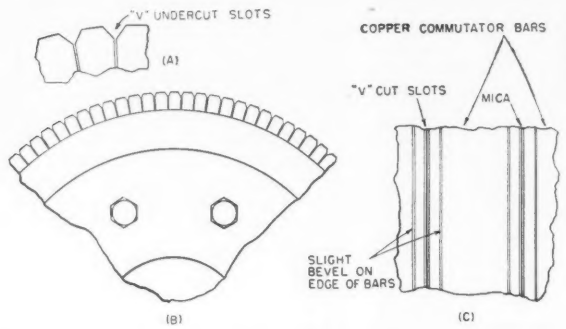


Fig. 8. How the mica should be undercut between the commutator bars

periodic inspections should not be substituted for more frequent inspections by the maintenance crew in charge of the elevators. Frequent inspections will help insure discovery of dangerous conditions that may develop between municipal inspections. Elevators, with their several safety features, are probably the safest public transportation means in existence. But they are dangerous, and this danger can be minimized only by frequent and careful inspections to insure that no protective device be permitted to remain out of order.

If guide rails develop noise due to rough spots, the best procedure is to apply a coating of machine oil and powdered sulphur to their running surfaces. This should be done also when new cast iron shoes are installed. Usually after a day or two the objectionable noise will disappear. If a quantity of dust or grit has gotten on the rail, it will be necessary to wash the rail down from top to bottom of the shaftway, using cloths saturated with carbon-tetrachloride. The car guide shoes that run on that rail should be removed and cleaned in the same manner. The best procedure is to start at the top of the shaftway. Use a saturated cloth and carefully wipe about two or three feet of the rail while standing on the roof of the car. Then use a clean dry cloth to finish wiping that section of rail. Then proceed to the next lower section of rail and repeat the process. Change cloths frequently since they will become dirty and gritty, and may not remove all the grit from the rail if used too long. When the car reaches the bottom of the shaftway, remove the guide shoes and clean them, clean the parts of the rail that cannot be reached from the top of the car, and replace the guide shoes. It will probably be necessary to use a ladder from the shaftway pit to clean the bottom part of the rails.

Elevator Company Mechanic Indispensable

Once a year a competent adjustment mechanic from an authorized elevator company should be employed to give each elevator a complete tune-up. This is just as necessary as with an automobile. He will be equipped with the necessary instruments, tools and test weights to do the job well. He will adjust the brake to stop the car smoothly with the test load, and will inspect and adjust all contactors and relays to see that they function properly and in correct sequence. This is very necessary to insure that the car will operate smoothly and responsively, will accelerate and decelerate correctly, will stop smoothly but positively, and in the case of automatic leveling or self landing elevators, will level at the floor in both directions within the prescribed leveling limits, whether the car be empty or fully loaded. He will also test the car governor safety stopping device and seal it, if requested, to insure its instantaneous operation in the event of an emergency. The small expense incident to such a checkup and adjustments once a year is money well spent in safety, service and satisfaction.

Smoothing Grooved Commutators

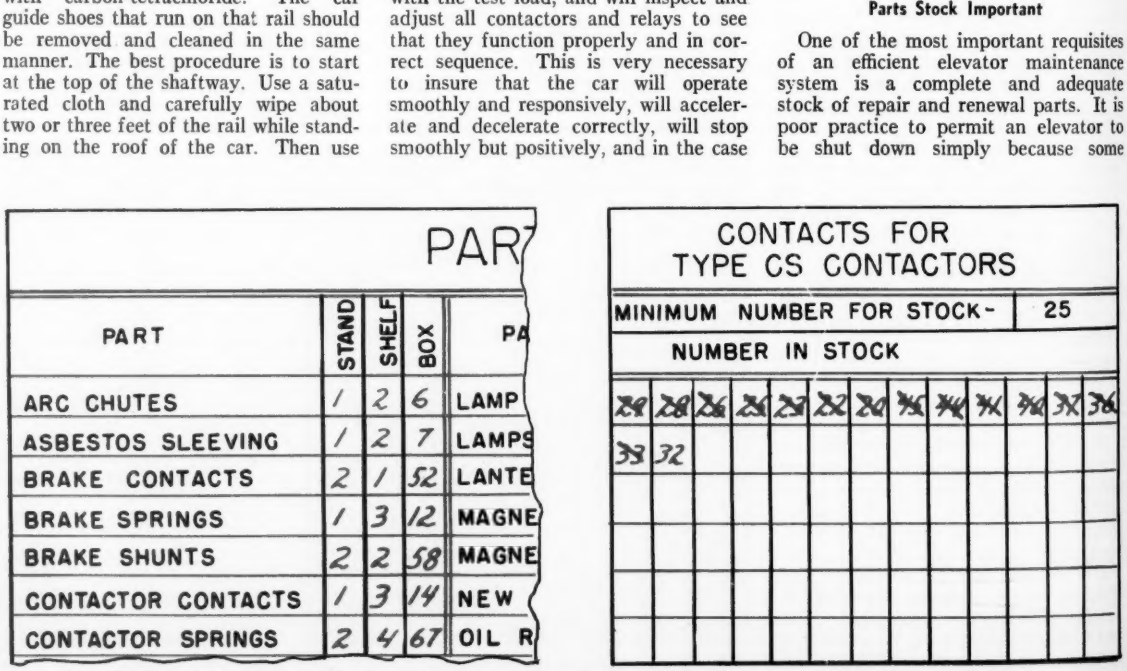
Occasionally it may be necessary to grind smooth the surface of rough or grooved commutators or slip rings. The rotor can be removed and sent to an electric repair shop for this purpose, or the job can be done by the maintenance crew if they have a suitable commutator grinding tool. In the case of slow speed hoist motors this job should be done by means of a rotary commutator grinding tool. This work is preferably done by an elevator mechanic skilled in grinding such commutators.

On most machines the mica insulated slots between commutator bars require undercutting (Fig. 8) as the copper bars wear down with use. It is good practice to keep this mica about $\frac{1}{16}$ inch below the surface of the copper bars.

Oil escaping from motor and generator bearings can cause serious trouble and damage to commutator. It mixes with the carbon brush dust and jams the brushes in their holders, as well as forming greasy carbon dust deposits between the commutator bars. Commutator mica insulation is susceptible to damage by oil ,and oil can cause short circuits and grounds in the commutator. This often results in armature coil burnouts.

Parts Stock Important

One of the most important requisites of an efficient elevator maintenance system is a complete and adequate stock of repair and renewal parts. It is poor practice to permit an elevator to be shut down simply because some



PAR

PART	STAND	SHELF	BOX	PA
ARC CHUTES	1	2	6	LAMP
ASBESTOS SLEEVING	1	2	7	LAMPS
BRAKE CONTACTS	2	1	52	LANTE
BRAKE SPRINGS	1	3	12	MAGNE
BRAKE SHUNTS	2	2	58	MAGNE
CONTACTOR CONTACTS	1	3	14	NEW
CONTACTOR SPRINGS	2	4	67	OIL R

CONTACTS FOR TYPE CS CONTACTORS

MINIMUM NUMBER FOR STOCK -	25

NUMBER IN STOCK

29	28	26	25	23	22	20	35	34	33	31	37	36
33	32											

Fig. 9. Parts index charts enable the maintenance crew to keep a running inventory of parts, tells when to order more

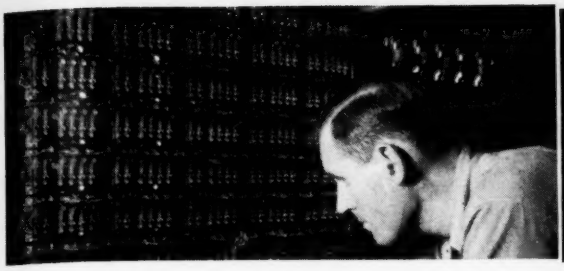


Fig. 10—Left. A modern signal board contains many relays.

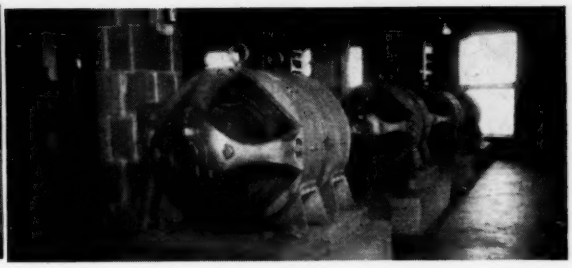


Fig. 11—right. Here is a group of motor-generator sets used on variable voltage elevators

small part, probably costing only a few cents, is not in stock. An investment in a good repair parts stock is an investment in continuity of service. Repair parts should be kept in covered boxes on shelves. A convenient wall chart (Fig. 9) listing all parts alphabetically and their box, shelf and stand location, will prove very helpful in locating a needed part. By keeping an inventory card in each parts box the stock can easily be maintained. The card should contain a notation of the minimum number of that particular part necessary to be kept on hand. Another notation should show the number actually in stock. Each time a part is removed for use the latter number is changed to correspond. When this number reaches the minimum level, additional supplies of this part are ordered from the factory to replenish the stock. This system prevents the danger of overlooking stock shortages.

Weekly Inspections, Too

In addition to the general inspection that each elevator should receive once a month, simpler weekly inspections should be made. This would include a checkup of all lubrication needs, contacts, contact shunts, brushes, commutators, signal lights and equipment, dust blown from all motors, generators and control boards, etc. Every day a routine checkup should be made of each elevator to determine whether it is functioning properly. The car should be operated for a few test trips and its operation noted. Signals should be observed, as well as lights, fans and other pieces of equipment. Any discrepancies should be remedied before placing the car in service or at the first opportunity afterwards.

The subject of safety cannot be stressed too strongly in regard to elevator maintenance work. Never take chances! Always shut off the current from a machine on which you are going to work, or which you wish to examine. Be sure your fellow workmen understand you before operating the equipment. Make certain that nobody is in a position of danger before you attempt to move an elevator. Be very careful of open shaftway doors. You or someone else may step through without thinking. Use caution in handling tools. A tool dropped into a running machine or down a shaftway can have disastrous results, can even inflict serious injury upon someone.

By establishing an efficient system of inspection and maintenance, such as the one here outlined, an elevator installation can be maintained at its peak efficiency. The ultimate in mechanical perfection built into the equipment can be obtained and maintained, and with it the high level of speed, safety and service to which the public has been educated to expect and whose absence it will be quick to note. In this age of speed and efficiency, the prestige of a building will doubtless be reflected in its elevator service more than in any other single service factor.

POWER CIRCUIT BREAKERS

Power systems have expanded in size and more interconnections have been made between systems. As a result the interrupting duty on high-voltage power circuit breakers exceeds the ratings available a few years back. This has led to the development in the Westinghouse high-power laboratory at East Pittsburgh of larger grids for oil breakers and interrupters for air breakers. The new De-ion grid, termed the Multiflow, can interrupt three and one-half billion kva. Two and one-half million was the previous top limit. It is expected that soon a multiflow grid will have been tested at five million or better. And that is no final limit.

The Multiflow type of De-ion grid differs from the older forms in that extinction is accomplished by forcing several jets of oil under pressure across the lengthening arc. This differs from the previous method for high-voltage interruption in which the arc is pulled magnetically into the oil. The result is faster arc interruption, and also a much smaller gas bubble. Because of this latter it has been possible to reduce the physical size of the circuit breaker tanks by as much as 50 per cent. This resulted in a much smaller consumption of steel and insulating oil when both were critically short.

These same power-system changes during the emergency period required also that the interrupting time be speeded up. Changes in design have made available five-cycle breakers in the higher voltage classes where eight or twelve-cycle interrupting was acceptable not many years ago.

The performance of the Multiflow grid as demonstrated in the high-power laboratory shows that these breakers can be used for fast reclosing times of twenty cycles or better. Automatic reclosing on high-voltage transmission lines is increasing in popularity and as many as one third of the breakers now being installed are provided with mechanisms suitable for fast reclosing.

The improved performance of new circuit breakers can also be obtained in many breakers that have been in service for years. Multiflow grids have been added where such improvements were found necessary. In many cases the performance of these old breakers has been substantially improved.

Improvements in indoor, low-voltage, high-capacity power circuit breakers have taken a somewhat different turn during the past five years. The development of the compressed-air circuit breakers has been carried to a point that several hundred of these breakers are now in satisfactory service.

The extent to which compressed air breakers will be used for high-voltage outdoor applications is still an open question. In their favor is the ever-present desire to eliminate oil. However, tests indicate that other hazards are introduced. All designs considered thus far have limitations in the manufacturing cost, because it is difficult to install current transformers and potential devices in this breaker as easily as with a conventional dead-tank breaker. Other factors are mechanism complication, insulation, and weather proofing. Space limitations also make this apparatus less desirable, and in many cases may be a deciding factor. Experience shows the oil hazard to be negligible especially with the smaller quantities used in the new breakers.

Design work has been underway leading toward the production of apparatus for voltages above 287 kv, the present maximum operating voltage. Power systems in the United States and also other countries will soon require apparatus with a voltage rating of the order of 400 kv. Recent studies have proven that this is quite feasible without fundamental changes in interrupter design.

How to Estimate Turbine Performance with Uncontrolled Extraction

By EDWARD V. POLLARD Turbine Engineering Division General Electric Co., West Lynn, Mass.

AUTOMATIC EXTRACTION steam turbines are often provided with one or more uncontrolled extraction openings from which steam is extracted in small quantities for process or feedwater heating. These applications cover the range in which the use of multiple automatic extraction is not economical.

The uncontrolled extraction opening has no internal valve regulating the pressure and, since the stage following this opening has a constant nozzle area, the absolute pressure at the opening depends only on the quantity of steam passing through the following stage and consequently has no direct relation to the flow in the stages preceding the opening.[1]

This article presents a method for estimating the performance of uncontrolled extraction points for extraction turbines. Methods for estimating the performance of single and double-automatic extraction turbines have been published by L. E. Newman in POWER PLANT ENGINEERING, January, February, March and April, 1945.

Before describing the specific method, a study will be made of the turbine manufacturer's procedure for constructing performance charts for uncontrolled extraction turbines (no automatic extraction).

General Theory for Determining Performance of Uncontrolled Extraction Turbine:

The manufacturer has available all the data pertaining to the steam path. He can segregate the used energy in each section of the turbine and, with the respective steam flows, can calculate the output of the individual sections and then combine these to find the turbine output under any desired condition.

Referring to Fig. 1, the lower line is a flow versus output curve for a turbine when operating non-extraction. (This curve may be for either a condensing or non-condensing turbine).

From specified data the manufacturer selects a location for the extraction opening and calculates the flow to following stage versus shell pressure curve at this point; such as Fig. 2a for a condensing turbine and Fig. 2b for a non-condensing turbine.

It is always desirable to start constructing the extraction performance curve at the minimum extraction pressure so the fulfillment of commitments may be checked relatively early. Hence, assuming a condensing turbine, Fig. 2a is entered at the shell pressure corresponding to the minimum pressure (a) and the flow to following stage (A) is read. When the flow (A) is indicated on the non-extraction flow curve on Fig. 1, it shows the load which has the minimum shell pressure at the extraction opening.

The manufacturer now calculates the output of the high pressure turbine section from inlet to extraction opening using a series of throttle flows such as (A) = no extraction flow, (B) = (A) + constant extraction flow, (C) = (A) + 2 times constant extraction flow, etc.; all calculations are made from inlet pressure down to pressure (a). The output of the low pressure section is now calculated for flow (A) using an initial pressure of (a) and initial enthalpies equal to the exhaust enthalpies at (A), (B) and (C) successively. Outputs (KA), (KB) and (KC) are obtained by adding the high pressure outputs to low pressure section outputs for flows (A), (B) and (C) respectively. These points are plotted on Fig. 1.

How Manufacturer Gets Lines of Constant Shell Pressure

By derivation, point (A,KA) lies on the line for non-extraction operation and points (B,KB) and (C,KC) are points on lines of one unit of extraction and two units of extraction respectively. A line through points (A,KA), (B,KB) and (C,KC) is a line of constant shell pressure.

Similarly, with shell pressures (d) and (g), data are calculated for points (D,KD), (E,KE) and (F,KF) for shell pressure (d); and (G,KG), (H,KH) and (M,KM) for shell pressure (g). These points are plotted on Fig. 1. Solid lines of constant extraction flow are drawn as shown. Dotted lines of constant shell pressure are then drawn as shown. In actual practice the non-extraction flow versus output is first estimated in order to furnish a starting point for calculations, and it is finally drawn through points (A,KA), (D,KD) and (G,KG).

As defined in L. E. Newman's papers cited above, the extraction factor is the

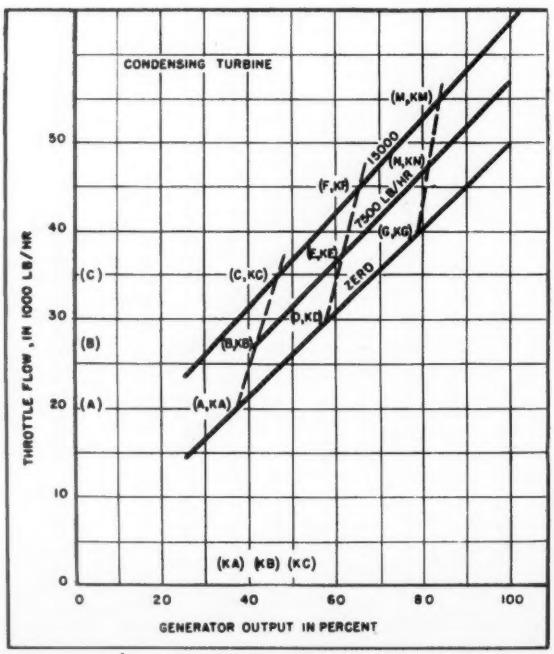


Fig. 1. Performance chart for uncontrolled extraction turbine (no automatic extraction) as calculated by turbine manufacturer by methods discussed in this article. Numerical values omitted; chart shows method only

[1] For further explanation see Chapter II, Modern Turbines, by L. E. Newman (John Wiley & Sons, 1944).

Another "first" on a rather tricky extraction turbine problem . . . Pressure at uncontrolled extraction opening varies, depending on steam flow through following stage . . . Author shows first the general theory and method used by turbine manufacturer to calculate performance . . . Then shows how to calculate and plot chart for a 4000-kw, 400-psi, 700-F condensing turbine with one uncontrolled extraction opening . . . Following this, he shows how to calculate performance with uncontrolled extraction in addition to automatic extraction and at either higher or lower pressure than the latter . . . Complete details on how to make performance chart, calculations, step-by-step method . . . Follow these instructions and you can work out charts to fit your particular turbine conditions

portion of a pound of steam which must be added to the throttle flow for each pound of steam extracted.

Notice that the lines of constant extraction flow on Fig. 1 diverge as they go from left to right. This is an indication of increasing extraction factor and is the proper characteristic, because shell pressure is increasing from left to right and the extraction factor increases with increasing shell pressure. Since the flow to stage following the uncontrolled extraction opening increases as the shell pressure increases, it is apparent that the extraction factor increases as the flow to following stage increases.

We now have an uncontrolled extraction performance curve on a condensing turbine, Fig. 1, constructed by making calculations at constant pressure at the uncontrolled point. This pressure depends only on the flow to following stage which must be constant if pressure is to be constant.

At constant load, when extracting at a constant pressure, there is only one point on the performance chart. At this point the difference between the throttle flow with extraction and the throttle flow non-extraction equals the extraction flow times extraction factor.

Case I—How to Estimate Uncontrolled Extraction Performance for Straight Condensing or Non-condensing Turbines as in Fig. 6.

Estimated uncontrolled extraction performance data on a given condensing or non-condensing turbine can be obtained by the use of estimated shell pressures, and extraction factors from Fig. 3. This assumes that a non-extraction flow curve as on Fig. 4, has been constructed from data not supplied in this article. For estimating purposes a curve of flow to following stage versus shell pressure, similar to Fig. 2A or Fig. 2B, may be drawn to meet the minimum load requirements; that is, uncontrolled extraction of a given quantity of steam at a given pressure at a given minimum load. Be optimistic at this point; assume that a turbine can be designed to meet the above requirements, and take the next step to determine the flow to following stage at the given pressure.

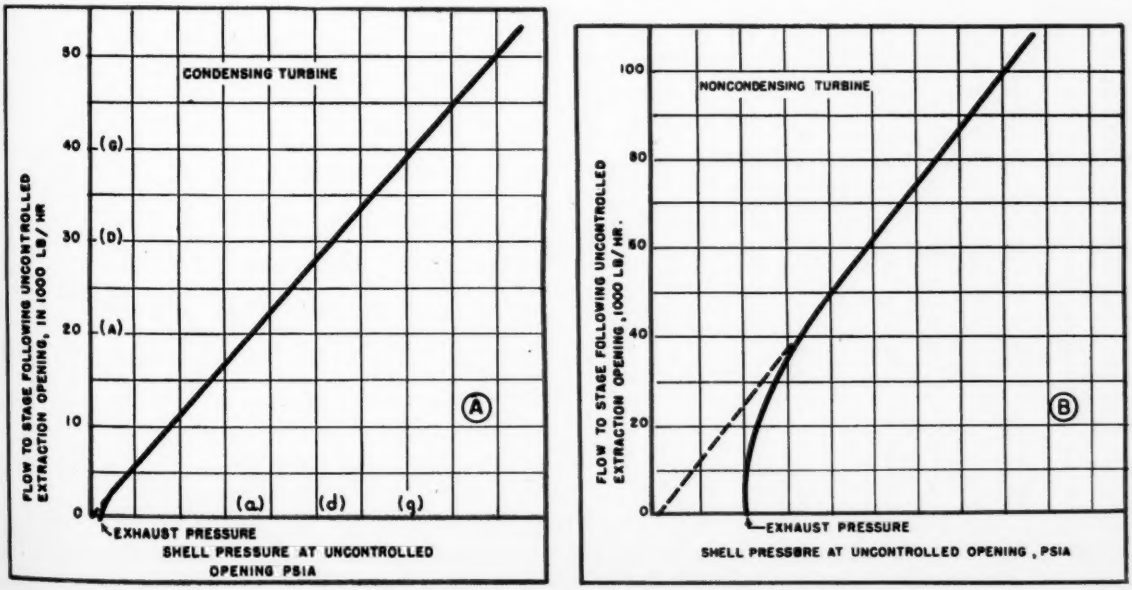
How to Find Flow to Following Stage

First read the extraction factor from Fig. 3 at TSR_1/TSR_2. TSR_1 is the theoretical steam rate from initial conditions to exhaust and TSR_2 is the theoretical steam rate from initial conditions down to the uncontrolled extraction pressure. Tables of theoretical steam rates are available[3] or they may be calculated from the steam tables.[4] Multiply the extraction flow by this extraction factor and add the result to the non-extraction throttle flow at the minimum load to obtain the throttle flow when extracting. Now subtract the

[3] Theoretical Steam Rate Tables by Keenan and Keyes, ASME, 1938.
[4] Thermodynamic Properties of Steam, by Keenan and Keyes, John Wiley & Sons, 1936.

Fig. 2. Graphs showing flow to stage following uncontrolled extraction opening versus shell pressure at controlled extraction opening, for: A—condensing turbine, B—non-condensing turbine

Figures 1, 2A and 2B are drawn to indicate the method only, regardless of numerical values of the horizontal axis. Figures 2A and B indicate that a straight line through the 0 — 0 intercept could be used for shell pressure curve and that actual shell pressure diverges from this curve at lower flows to following stages. These curves must be plotted by manufacturer in order to draw Fig. 1.



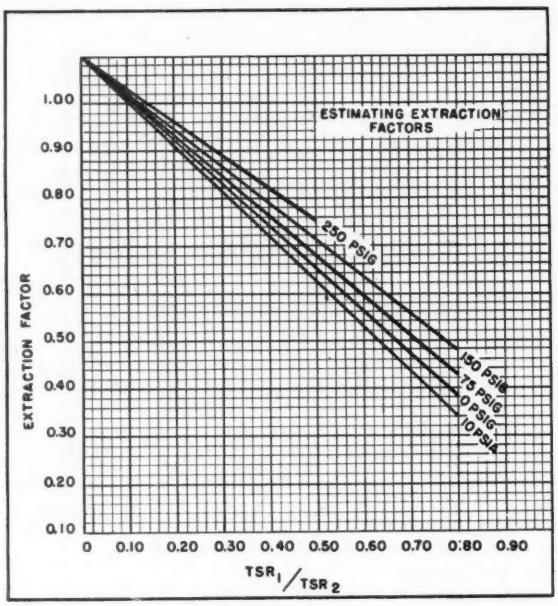


Fig. 3. Graph for estimating extraction factors for various values of TSR_1/TSR_2

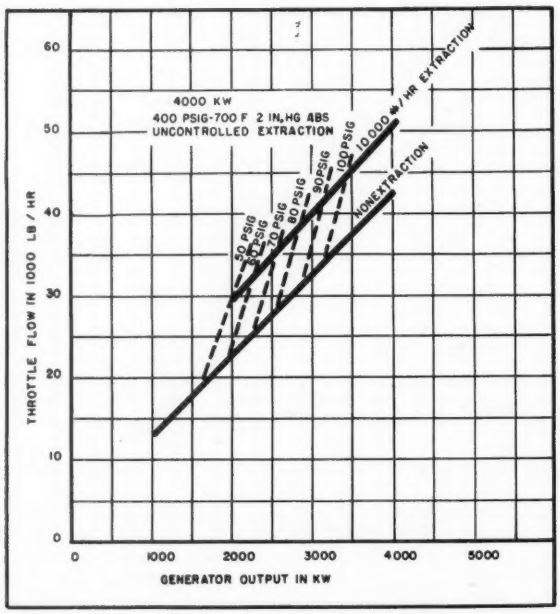


Fig. 4. How a non-extraction flow curve and performance chart are constructed for turbine of Case I as discussed in text and shown in Step-by-Step Method on opposite page, for a 4000-kw, 400-psig, 700-F, 2-in-Hg condensing turbine with one uncontrolled extraction opening. Turbine as shown in Fig. 6

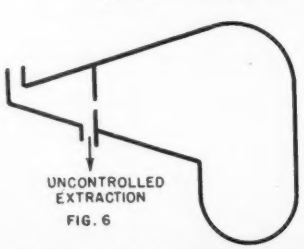


Fig. 6. Diagrammatic arrangement of turbine of Case I with one uncontrolled extraction opening

extraction flow from the throttle flow to obtain the flow to following stage which produces the desired shell pressure. **The Step-By-Step Method**, tabulated on page 77, follows the above procedure for an actual turbine application with the resulting data plotted on Fig. 4.

How to Calculate and Read the Data

Plot a curve as in Fig. 5, similar to Fig. 2, using the flow to following stage just found and the desired shell pressure in pounds per square inch absolute as one point.

From the above data used to find the shell pressure line, two points were found which will establish the minimum shell pressure curves; first, throttle flow with extraction and corresponding load and second, throttle flow without extraction which can be plotted on non-extraction line of Fig. 4.

Additional lines of constant shell pressure can now be constructed in the following manner. At a certain pressure, read the flow to following stage from Fig. 5. Next find the theoretical steam rate ratio using TSR_2 found at the new shell pressure. As before, enter Fig. 3, and read the extraction factor from the proper line, interpolating when necessary. Multiply the extraction factor by the selected value of extraction flow to obtain the increase in throttle flow, symbol ΔF_T at some constant load with the selected extraction flow and the selected extraction pressure.

How to Construct the Performance Chart

Figure 7 shows diagrammatically the construction of the uncontrolled extraction performance chart which is done in the following manner.

On the line drawn through the nonextraction flow versus output points, Fig. 4, locate the flow to following stage corresponding to the selected pressure. To this flow add the extraction flow to find the throttle flow when extracting. From this throttle flow subtract ΔF_T to find the throttle flow nonextraction which satisfies the conditions of the point being discussed. On the non-extraction line with this flow, locate the output, and at this output move vertically to the throttle flow when extracting, see Fig. 7. This point is on the line of constant shell pressure, and, therefore, a line may be drawn through this point and the point on the non-extraction flow

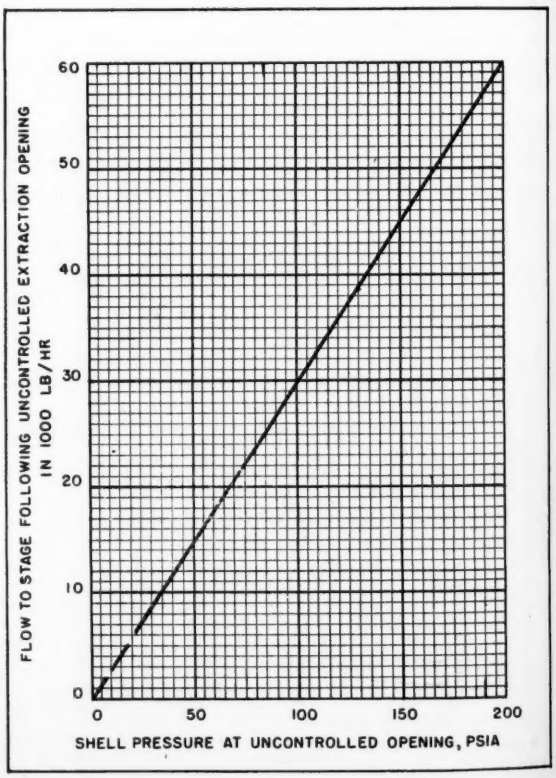


Fig. 5. Curve for flow to following stage versus shell pressure at uncontrolled extraction opening for the turbine of Case I, Fig. 6. Data from this curve used in plotting Fig. 4

STEP-BY-STEP METHOD

Results Plotted on Fig. 4

4000 kw—0.8 pf—5000 Kva—60-cycle Condensing Steam Turbine Generator Set

Steam Conditions:

Main Pressure ..... 400 psig
Initial Temperature ..... 700 F
Exhaust Pressure ..... 2" Hg abs
Uncontrolled extraction of 10,000 lb per hr at 50 psig at 2000 kw and higher loads

KW	TSR_1 Lb/Kw hr	TSR Factor*	Steam Rate Lb/Kw hr	Flow
2000	7.60	1.525	11.60	23,200
4000	7.60	1.410	10.72	42,880

At 50 psig Extraction.

$$\frac{TSR_1}{TSR_2} = \frac{7.60}{18.47} = 0.412 \qquad \text{Extraction Factor} = 0.638 \text{ (From Fig. 3).}$$

At 2000 kw extracting 10,000 lb per hr at 50 psig
Throttle flow = 23,200 + 10,000 × 0.638 = 29,580
Extraction flow = 10,000
Flow to stage following extraction opening = 19,580

Shell Pressure psig	Shell Pressure psia	TSR_1	TSR_2	TSR_1/TSR_2	Extraction Factor	Base Flow	Throttle Flow	ΔF_T	Equivalent Non-Extraction Flow	KW
50	64.7	7.60	18.47	0.412	0.638	19580	29580	6380	23200	2000
60	74.7	7.60	19.70	0.386	0.670	22600	32600	6700	25900	2270
70	84.7	7.60	20.98	0.362	0.690	25600	35600	6900	28700	2560
80	94.7	7.60	22.31	0.341	0.708	28600	38600	7080	31520	2850
90	104.7	7.60	23.68	0.321	0.725	31600	41600	7250	34350	3135
100	114.7	7.60	25.09	0.303	0.740	34600	44600	7400	37200	3420
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

(1) Assumed Values
(3) } From Theoretical Steam Tables or calculated from Steam
(4) } Tables.
(6) From Fig 3.
(7) Flow to stage following uncontrolled extraction opening, from Fig. 5 at shell pressure (2).
(8) 10000 + (7)
(9) 10000 × (6)
(10) (8) — (9)
(11) Zero extraction or reference curve at (10).
* Modern Turbines, by Newman, page 33.

versus output line equal to the flow to following stage used above. Also, this point is on a line of constant extraction which should not be constructed until lines of other constant pressures have been worked up.

Repeat this same procedure for other shell pressures and construct similar lines of constant shell pressure, using in each case the same quantity of extraction flow. The points of constant extraction flow on the shell pressure lines may now be connected, and with a sufficient number of constant extraction flows used in the above method, a performance curve for uncontrolled extraction is obtained, Fig. 4.

Case II—How to Estimate Uncontrolled Extraction Performance at a Pressure Higher Than Automatic Extraction Pressure as in Fig. 8.

The construction of estimated uncontrolled extraction performance, in addition to automatic extraction, follows the same procedure. In this case, however, the base or reference line for zero uncontrolled extraction performance is taken as one line from the performance chart of the automatic extraction turbine. Since the uncontrolled extraction is at a higher pressure than the automatic extraction, the increase in output for uncontrolled extraction with a constant flow in the following stage may be calculated in the same manner as the corresponding value in a non-automatic extraction machine. An uncontrolled extraction performance chart can, therefore, be constructed on this one line taken from the automatic extraction chart as a base.

It will be noticed, as mentioned previously, that as long as the pressure in the uncontrolled opening is the same, the extraction factor will be the same. This same procedure could be followed, using each of the lines from the automatic extraction chart as a base, **and it would be found that as long as the flow to the following stage is the same, the extraction is the same. Therefore, it is necessary to figure the performance curve for only one extraction line as a base.**

The most convenient way to plot these data is to follow the procedure outlined for double-automatic extraction in Mr. Newman's article as far as the low-pressure automatic extraction is concerned. In this left-hand section of the chart, Fig. 9, the uncontrolled extraction performance, using the one line from the automatic extraction chart as a base or reference line, is constructed. Data are derived from this chart in the same manner as described for a double-automatic extraction turbine.

That is, one can start with load, move vertically to extraction at the low pressure, move horizontally to reference axis, move vertically to uncontrolled extraction flow and then move horizontally to throttle flow. (See guide lines). It will be noticed that any point on the reference axis has the same throttle flow for the low pressure extraction operation, regardless of the magnitude

(*Continued on page 102*)

Wilder Hydro Re-development on Connecticut River

By **C. R. BLISS** Designing Engineer, New England Power Service Co.

At historic Wilder site above White River Junction, Vt., present 5,000-kw hydroelectric plant insufficient to meet power requirements of area . . . To make greatest economic use of water resources, plans now under way for new dam, power house containing two 22,000-hp adjustable-blade propeller type hydraulic turbines . . . New 110,000-v transmission line to connect Wilder with transmission network of the New England Power System at Bellows Falls

AT A STRETCH of the Connecticut River originally known as White River Falls, there is evidence of the existence as far back as 1785, of a wing dam supplying water to small mills for grinding grain, sawing wood and the like. Later, in 1810, locks were built there; in 1880 Wilder Bros. acquired water rights for a paper mill and in 1926 the old dams were replaced by a concrete dam. Paper production decreased and finally stopped at this mill in 1927. Since that time the plant has been used solely to furnish electricity for this area. It is now proposed to redevelop this site.

Power Plant Built in 1910

The present plant consists of a dam with a spillway about 635 ft long and a canal along the Vermont shore leading to two power houses. One of these was constructed as a power plant in 1910 and furnished electricity for the paper mill. The other was originally a grinder room but, as the manufacture of paper decreased, electric generators were connected to the grinder wheels from time to time. There is now a total of five generating units in the two power houses with a total installed capacity of about 5,000 kw.

Proposed re-development of the site is the result of studies carried on for many years and is designed to make the greatest economic use of the water resources of the Connecticut River in this area. The present plans contemplate, in general, a development as outlined below, to be carried out by the Bellows Falls Hydro-Electric Corp.

The dam will be located at the lower or "Narrows" site, about three-fourths of a mile downstream from the present dam and will be of concrete founded on ledge with earth embankments at either end. Total length of the dam and embankments will be about 1,500 feet and it will have a spillway divided into five sections to include pintype flashboards, stanchion type flashboards, five Taintor gates and two skimmer gates, one at each end. The discharge capacity of the new spillway and gates will be over 160,000 cu ft sec, or 75 per cent greater than maximum flood on record. It is materially in excess of the capacity of the present dam.

The general appearance of the dam will be somewhat similar to that at McIndoes Falls farther up the Connecticut River although the Taintor gates at Wilder will be considerably larger and the total discharge capacity of the spillway will be over twice that of McIndoes. Top elevation of gates and flashboards, will be 385 ft. above mean sea level which is about 16 ft higher than the present development. This will result in a pond, extending to a point some four miles below Wells River, which for the most part will be contained within the present river banks.

Generator in Each State

The powerhouse will be integral with the dam near the Vermont shore and will contain two generators, one in each state, with a nominal capacity of 15,000 kw each, driven by adjustable blade propeller type turbines of 22,000 hp each. Outside the powerhouse will be transformers and a switchyard providing for connections to the Granite State

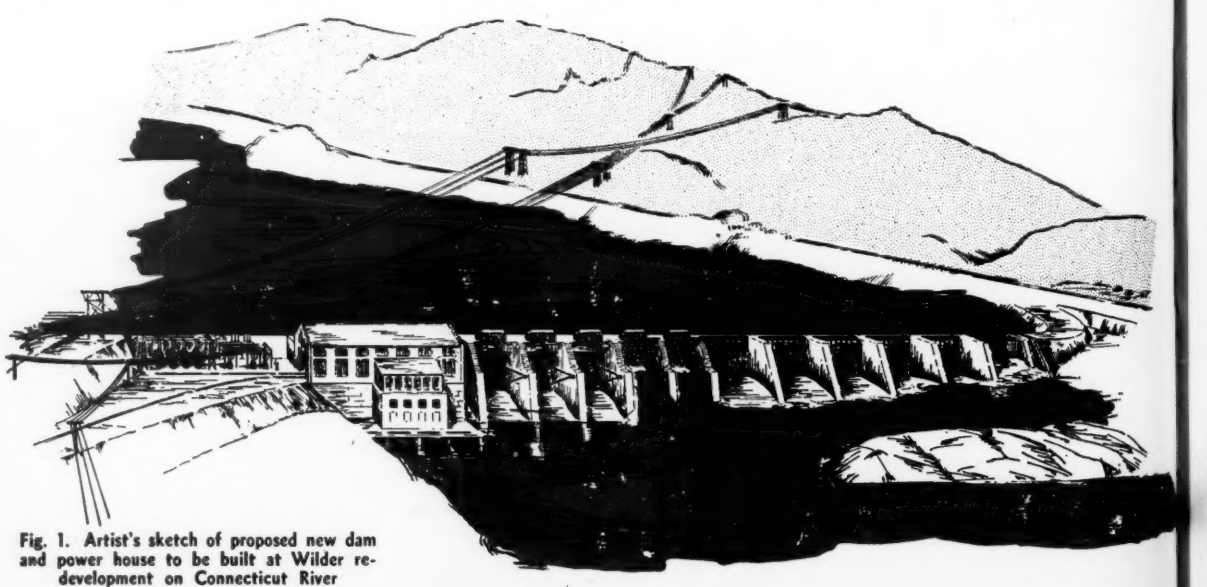


Fig. 1. Artist's sketch of proposed new dam and power house to be built at Wilder redevelopment on Connecticut River

Electric Co., Green Mountain Power Corp. and Central Vermont Public Service Corp. and to a new 110,000-v transmission line connecting Wilder with the Bellow's Falls Hydro-Electric plant. This latter connection will provide a tie with the interconnected transmission network of the New England Power System over which power can be interchanged, making it possible for System steam relay to back up the Wilder hydro power when river flows are low, and further making available large amounts of primary power beyond the capacity of the proposed plant when such power is needed in Vermont and New Hampshire in the contiguous areas.

State and Federal Approval

The Wilder re-development must satisfy the requirements and receive the approval of various State and Federal regulatory bodies. The present development is licensed under the Federal Power Commission and the license requires among other things that the site be re-developed in accordance with such plans as are best adapted to a comprehensive plan for the improvement and utilization of water power development of the Connecticut River when economic conditions permit.

The present license stipulates that a fishway be installed upon re-development in accordance with the requirements of the Secretary of the Interior.

The present dam will be breached and the spillway discharge capacity of the new dam will provide for passing a flood similar to the great flood of March, 1936 at the same or a lower elevation than that which occurred at that time.

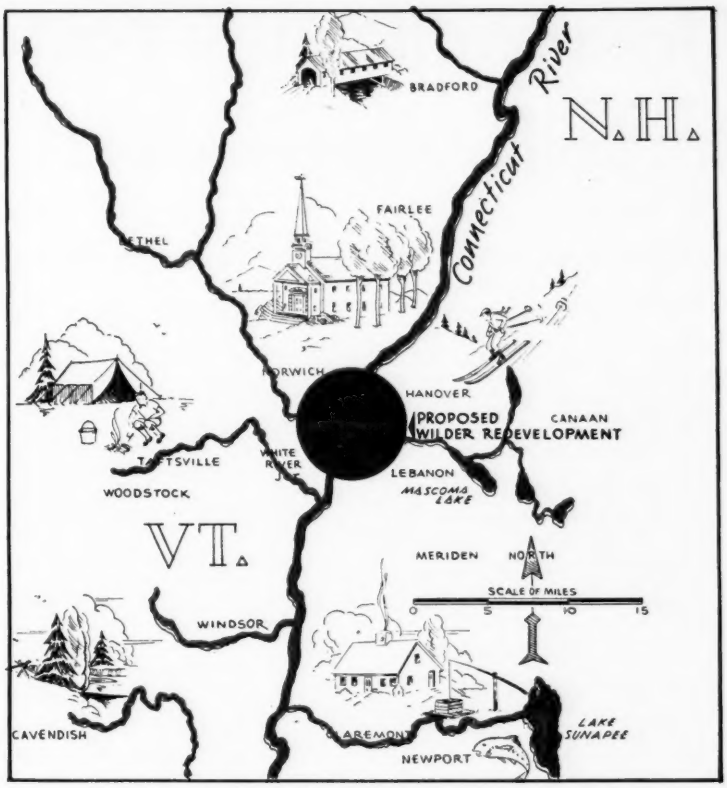


Fig. 3. Map showing relation of Wilder site to surrounding territory

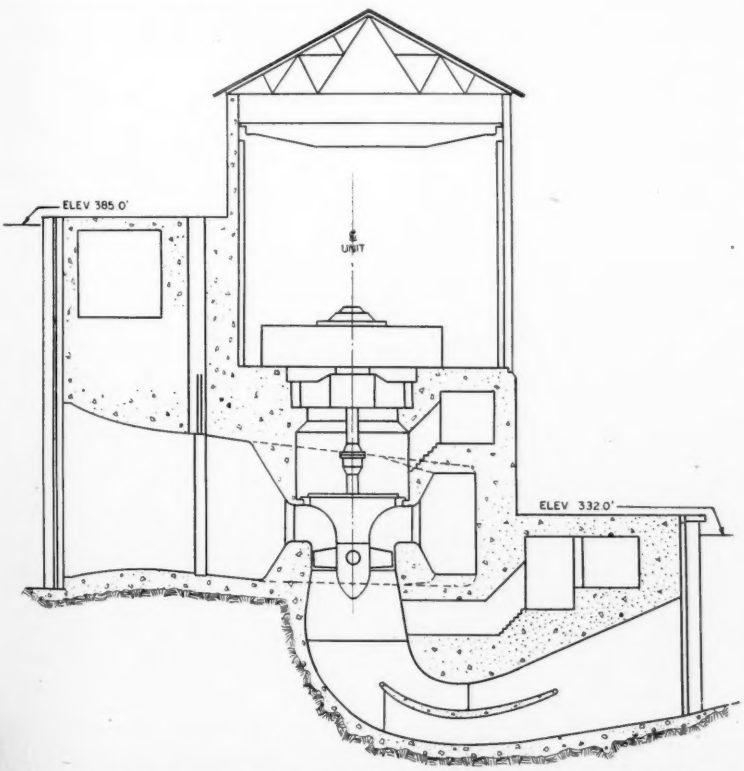


Fig. 2. Cross-section through proposed power house at Wilder re-development, showing one of two 22,000-hp adjustable-blade propeller type turbines, each driving a 15,000-kw generator. One machine in Vermont, other in New Hampshire

The total amount of tillable land which will be flowed or become affected as a result of the re-development is about 500 acres, fairly evenly divided between New Hampshire and Vermont, which is very small for a project of this size.

A pond some 46 miles long with comparatively minor fluctuations will be created by the new dam and the flowed area will be cleared of trees and brush so that it will make available excellent opportunities for the development of boating, fishing and other recreational pursuits.

Such few changes in highways, culverts, sewers, telephone lines and the like as are made necessary by the re-development will be made at the expense of the Company.

The Company with its broad background of experience in the construction and operation of many similar projects over the last 30 years, stands ready to assist the towns and other public bodies in working out such matters as may arise in connection with the Wilder re-development.

It is estimated that the development will cost about $13,000,000, this amount being about evenly divided between New Hampshire and Vermont. Engineering design of the project is by New England Power Service Co.

Uncontrollability Factors in Boiler Operation

By **JOSEPH A. PELLETTERE** Engineering and Construction Dept., Gulf Oil Corp., Pittsburgh, Pa.

BOILER CONTROL offers a variety of problems. One who has not done work in this field will be surprised to find that so many unique problems do exist in such an installation.

The designer of a steam boiler plant (or of any process to be instrumentally controlled) must think of instrumentation in the early stages of design, and not regard instruments merely as accessories to be added at the end. For example, he should provide

a. Adequate straight runs for flow metering.
b. Adequate pump head to give water valve enough pressure drop to control properly.
c. Proper fan capacities, motor or turbine sizes, and type of speed controls.
d. Method of measurement of fuel and air, with proper piping and duct work.

These points are assumed to have been thought of and provided for in the original boiler design. The uncontrollability factors referred to in the title are those which are NOT the result of careless design, but rather those inherent in good design.

A Four-Function Problem

Boiler control is a four-function problem, as follows:

a. Combustion control — CO_2 approximately constant for all loads.
b. Water level control.
c. Furnace draft control.
d. Constant steam header pressure.

To these we might add a fifth consideration:

e. Safety interlocks (optional).

The fact that four functions must be controlled simultaneously is further complicated by the fact that controllers must have good stability for any position on the steam output chart or boiler generating range; and also by the fact that certain safety features must be met.

Interlocks

Interlocks are at present more in demand, due to war psychology. Because of the type of labor available, as well as "Seniority Rules," inexperienced operators often were found in difficulty. Such conditions have caused control designers to lean over backwards to provide extra safety protection.

The more common safety features being used are:

a. If air to furnace fails—fuel must be cut off.
b. If forced or induced fan fails—furnace must not build overfire positive pressure condition nor must any fuel be admitted under such conditions.
c. If burner pressure fails momentarily for any reason, fuel system must be shut down to prevent fuel return to hot brick work with burners in extinguished condition.
d. In all cases, it is desirable to prevent starting of forced draft fan until induced fan is in operation.
e. Fuel rate should never exceed air capacity or over-range boiler design output.
f. Flame failure detectors to cut off fuel.

The safety points can be developed by contact switches and solenoid valves; or, better in some cases, by good control layout involving Sequence Ratio Instruments that have the sequence set up so that combustion air failure shuts off fuel. Such a sequence control is shown in Fig. 1.

Such sequence ratio diagrams, however, increase the time lag of the control circuit and so increase the uncontrollability factor. This results from the fact that, on demand, the master pressure controller does not directly admit additional fuel, but increases the output of one of the fans, causes the airflow pen to rise, and, since it is ratioed to the fuel meter, thus to admit more fuel.

One can readily see that powering a large fan may in itself cause some delay due to system inertia; also, further waiting for the air meter to respond does not help the time loss situation.

This handicap has to be balanced against the use of contact switches and their related undesirable features. On "trip-out," boiler settings must be purged for a considerable period before fires can be relighted and this becomes serious when blind switches keep taking boilers off the line.

A system of switch interlocks on trip

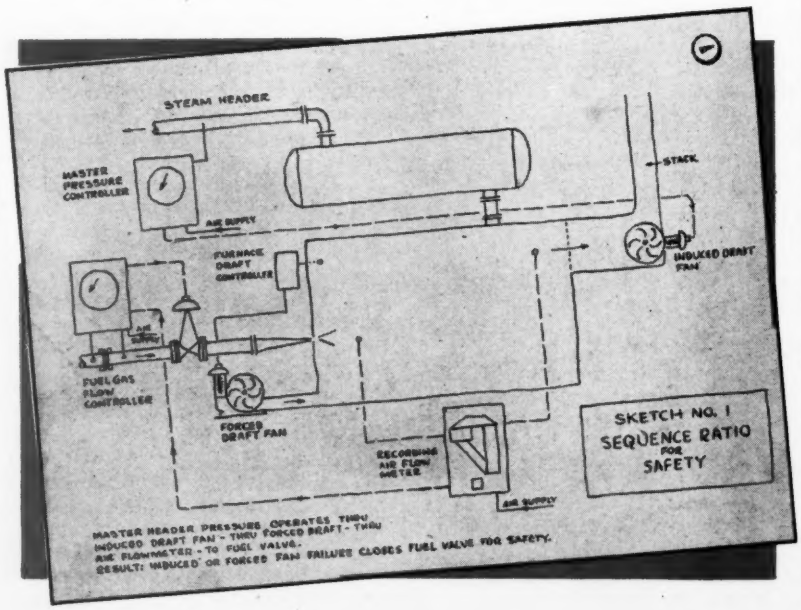

STEAM HEADER
MASTER PRESSURE CONTROLLER
AIR SUPPLY
STACK
FURNACE DRAFT CONTROLLER
INDUCED DRAFT FAN
FUEL GAS FLOW CONTROLLER
FORCED DRAFT FAN
RECORDING AIR FLOW METER
SKETCH NO. 1
SEQUENCE RATIO FOR SAFETY
MASTER HEADER PRESSURE OPERATES THRU INDUCED DRAFT FAN - THRU FORCED DRAFT - THRU AIR FLOWMETER - TO FUEL VALVE.
RESULT: INDUCED OR FORCED FAN FAILURE CLOSES FUEL VALVE FOR SAFETY.

Fig. 1. Sketch of a sequence ratio boiler control to incorporate safety precautions

Paper sponsored by Instruments & Regulators Division, ASME; delivered at joint meeting of Division with annual meeting of Instrument Society of America, Pittsburgh, September, 1946.

Factors referred to are NOT result of careless design but are inherent in good design . . . Their effects on design and operation of instruments and automatic boiler controls . . . Uncontrollability factors in valves . . . Effects of reversed level signal . . . Level control and economic design . . . Difficulties in using CO_2 analyzer as control instrument . . . Influence of fuel meters . . . Mixed fuels and the air requirement . . . Boiler room has been leader in control design . . . Instrument manufacturers have always solved problems . . . "The impossible takes only a little longer"

out leaves one to guess which of the 3 or 4 protection devices recognized conditions of danger and shut the boiler down. See Fig. 2.

Where sequence ratio circuits of fuel to air are used, one may allow the switch interlock system to sound an alarm but not perform the actual shutdown operation. This does not provide as much "paper" protection, but makes for continuous plant operation. For the time being, such switch interlocks are being converted to alarm systems by most of those who encounter operation trouble due to switch interlock system malperformance.

Uncontrollables in Valves

Uncontrollability factors also stem from the fact that air-flow and gas-flow control valves are of unusual design, consisting of vanes regulating fan capacity or a damper valve whose size is arbitrarily set at duct size by the designer and not by the control engineer's calculation. See Fig. 3 below, on this page.

Control engineers readily understand what oversized control valves do to stability of the system in simple setups where control stability is required for only one position—called normal load. In the case of a boiler, where no such thing as normal load condition exists, the instability of the system due to oversized control valve is many times more pronounced.

Correction or means of overcoming poor control valve characteristics lies in metering the air flow and using the impulse output of such a meter to correct the air fan in accordance with steam flow or direct CO_2 measurement. This is the same as saying that reset air flow meter operated by CO_2 analyzer is required and not plain CO_2 meter correction of air flow damper or vanes.

Effects of Reversed Level Signal

Modern boilers have a drum holding capacity that is relatively small. The modern tendency to reduce initial cost has reduced the number of drums to the minimum, and the holding capacity correspondingly.

When fire is applied to correct the falling steam header pressure, the level surges upward in the drum. Such a level swell is caused by change in specific gravity of the fluid in the tubes (i.e., increased volume of steam bub-

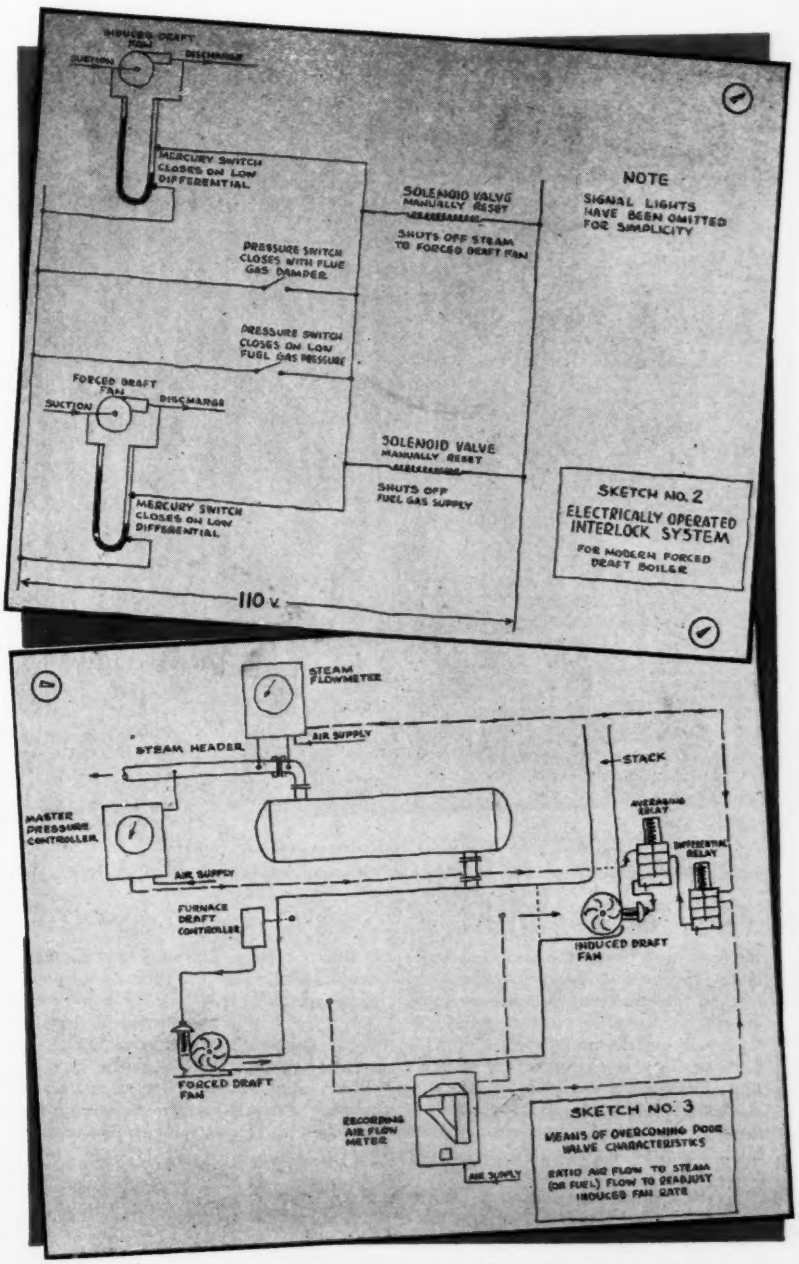
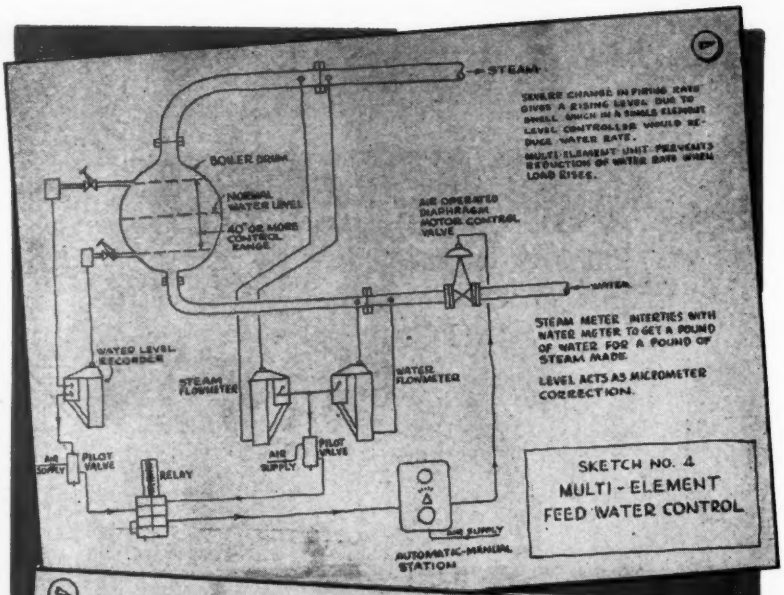


Fig. 2—Above. Sketch of an electrically-operated interlock system for a forced-draft boiler.
Fig. 3—Below. Sketch of a control system providing means of overcoming poor valve characteristic



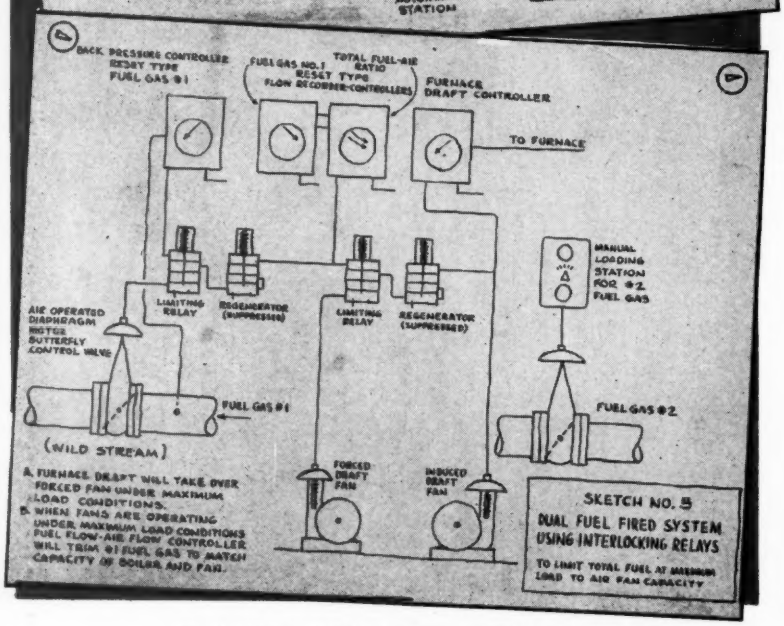

BACK PRESSURE CONTROLLER RESET TYPE FUEL GAS #1
FUEL GAS NO.1 RESET TYPE FLOW RECORDER-CONTROLLER
TOTAL FUEL-AIR RATIO
FURNACE DRAFT CONTROLLER
TO FURNACE
MANUAL LOADING STATION FOR #2 FUEL GAS
LIMITING RELAY
REGENERATOR (SUPPRESSED)
LIMITING RELAY
REGENERATOR (SUPPRESSED)
AIR OPERATED DIAPHRAGM MOTOR BUTTERFLY CONTROL VALVE
FUEL GAS #1
FUEL GAS #2
(WILD STREAM)
A. FURNACE DRAFT WILL TAKE OVER FORCED FAN UNDER MAXIMUM LOAD CONDITIONS.
B. WHEN FANS ARE OPERATING UNDER MAXIMUM LOAD CONDITIONS FUEL FLOW-AIR FLOW CONTROLLER WILL TRIM #1 FUEL GAS TO MATCH CAPACITY OF BOILER AND FAN.
FORCED DRAFT FAN
INDUCED DRAFT FAN
SKETCH NO. 5
DUAL FUEL FIRED SYSTEM USING INTERLOCKING RELAYS
TO LIMIT TOTAL FUEL AT MAXIMUM LOAD TO AIR FAN CAPACITY

Fig. 4—Above. Sketch of multi-element feedwater control
Fig. 5—Below. Sketch of dual-fuel-fired system using interlocking relays to limit total fuel at maximum load to fan capacity

bles) as well as by the fact that there is no appreciable drum storage space to hide this apparent increase in liquid volume, because the ratio of drum volume to tube volume is low.

Naturally a level instrument controlling under such a condition can only recognize high level conditions and reduce the feedwater rate at a time when the generation is rising, which is obviously incorrect procedure.

To overcome this condition of reversed impulse requires that the consistently truthful steam meter become party to an inter-tie system involving both the steam and level meters as joint operators of the feed water control valve.

Further considerations of the many factors that cause the differential pressure across the water valve to vary, when level itself is satisfied, and cause feedwater rate to vary, bring about the multi-element level control system which inter-ties level, steam, and water meters in a joint system to operate the one feedwater control valve, as shown in Fig. 4.

Difficulties in Using CO_2 Analyzer

Combustion control implies constant CO_2 at all loads as one function of control action. One would then look for the CO_2 analyzer to be the instrument applying the vernier correction to the air flow rate, in order to hold percentage of CO_2 in flue gas constant. However, such analyzers are handicapped by sampling line troubles and also have quite a long lag period between the time of CO_2 percentage change and the time the instrument pen is made to show the value. Both these points cause designers of combustion control systems in general to avoid the CO_2 analyzer as an automatic control instrument.

In at least one system, the steaming rate is used to measure the fueling rate or heat release at the burner in order to avoid poor performance of some heavy fuel oil meters, or the use of coal meters in coal fired boilers. Indirect coal measuring devices are too numerous to discuss in a short paper. This subject of coal-fired boiler devices alone could easily cover the time allotted for the major subject.

The steam meter, as above mentioned, is a good point for gaging fueling rate as Btu released at burner and setting up flow of air required to hold percentage CO_2 constant flue gases.

When boilers are fired by use of two or more fuels simultaneously the controlling of air rate to hold constant CO_2 in flue gas becomes complicated instrumentation in itself. Also for this condition (when operating two or more fuel valves) one also finds it hard to keep from over-fueling the boiler at top loads. Floating relay systems have been used to step in and take over the boiler and hold maximum conditions, as shown in Fig. 5; but in a short paper this subject cannot be covered in detail.

Conclusions

Boiler room practice, up to the present, has been a leader in instrument control design. One who encounters a new instrumentation problem should first endeavor to check whether or not commercial boiler house controllers have already encountered and conquered the problem, before embarking on what would seem to be a new field of research.

The desire of American manufacturers to reduce boiler initial costs has caused problems that, like the multi-element water level control system, complicate and raise the instrument costs.

I wish to point out that American instrument manufacturers, when confronted with a new problem, have always been able to develop a device to solve it. Perhaps they are justified in feeling that "the impossible takes only a little longer."

CHECK BOILER water treatment. Accumulations of rust or scale on any heating surface restricts full transfer of heat. Scale deposits are a major cause of boiler troubles in addition to wasting heat.

RECOVER THE heat in boiler blowoff water. Steam flashed in flash tanks can be used in open feedwater heaters. Heat exchangers recover remaining heat in blowoff discharge to sewer.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

WHAT DOES DAYLIGHT COST?

Offhand, most people would say that daylight costs nothing. This, however, is true only outdoors. Indoors, the cost of daylight is represented by the cost of windows and other skylights such as those of monitor and sawtooth roofs. To this must be added the overall cost of wasted rental space in providing light-courts and set-backs of the upper stories of skyscrapers. Maintenance of these, the loss of heat, and other factors are chargeable to daylight. Failing at least once a day, part of the cost of a standby artificial lighting system is also chargeable to daylight. We want windows to look out of but the "daylight habit" acquired in bygone eras of inadequate and relatively inefficient light-sources is now responsible for many costly and questionable practices. The inadequacy of daylight indoors is exemplified by the widespread use of artificial light in the daytime in stores, offices, factories and elsewhere in congested areas.

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Trigonometrical Nomenclature Chart 100

A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Operation Of Pulverized Fuel Systems

Requirements for safe lighting-off practice . . . What to do when ignition is lost . . . Types of permanent oil torches, gas torches and pulverized fuel torches . . . Interlocks and starting sequence for direct-fired system, storage system . . . Flame detectors . . . Furnace construction . . . Extinguishing fires in pulverizers or piping . . . Drawings of various pulverized fuel system arrangements shown

MANY EXPLOSIONS resulting in loss of life and property damage have occurred in furnaces fired with gas, oil or pulverized coal, due to improper lighting-off practices. The requirements of a safe lighting-off system vary so widely with fuel and equipment characteristics that detailed rules universally applicable cannot be written.

(10a) Before injecting pulverized fuel in a furnace: A flow of clean air equal to at least one-fourth that required for maximum output shall be produced through the furnace for at least five minutes to purge the furnace of any fuel and combustible gases that may have accumulated.

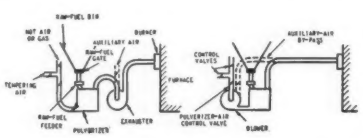


Fig. 1. Left. Direct-fired suction system. This arrangement differs from Fig. 2 only in the location of the fan. Fig. 2. Right. Direct-fired pressure system. No valves are required between the pulverizer and the burner for arrangements such as this or for Figs. 1 and 8.

Each burner shall be lighted by a torch. No burner shall be put in operation by ignition from a distant burner or from hot refractory.

Each torch should preferably be located so that its flame will approximately parallel and intimately mix with the fuel stream to obtain contact for an appreciable length of time.

The torch shall be so located as to avoid danger of its being snuffed out.

The torches should be functioning properly and kept in operation until all danger of losing ignition has passed.

If the ignition has not taken place in five seconds after fuel appears at the burner, fuel should be shut off and the furnace purged for five minutes. Drafts shall be checked and burners adjusted before inserting torch and repeating lighting operation.

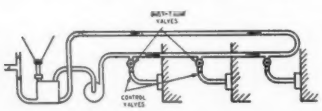


Fig. 3. Direct-fired circulating system. In this arrangement all burners branch off from a loop header and the excess fuel and air are returned to the pulverizer inlet

The torch should be cut out after satisfactory ignition is obtained. Torches left burning during regular operation may be a hazard, although there are some conditions such as a low load where their use is justified.

If ignition is lost when a unit is in operation and the furnace is hot, considerable hazard is present in relighting, and deliberate and well-considered action is generally safer than attempting hurried changes. When ignition is lost: (1) All fuels from all sources including any torches shall be shut off immediately. If the unit is operating on automatic combustion control, reset to manual control.

(2) The unit shall be purged before relighting. If ignition is lost at a relatively high rate of operation and the air flow is not reduced, purging takes place in a very short period of time. For this case (where ignition is lost when operating at above ¼ maximum rate and the corresponding air flow is allowed to remain unchanged) a 5-minute purge as a result of this air flow, shall be considered sufficient. It is not necessary, and in fact it may not be practical, to maintain the air flow at this high rate, particularly if the ignition was lost when operating near the maximum; hence the air flow may be reduced gradually provided it is reduced to not less than ¼ the maximum.

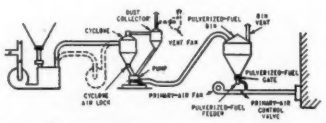


Fig. 4. This arrangement is a storage system with 100 per cent venting

If ignition is lost at a relatively low rate of operation, the safest procedure requires a longer time for purging, and no change in equipment settings that will change the air flow. For this case (where ignition is lost when operating at or less than ¼ maximum rate) the air flow setting should be left unchanged and the purging at this rate continued for a period of—5 minutes if at ¼ maximum rate; 10 minutes if at ⅛ maximum rate; 20 minutes if at 1/16 maximum rate.

(3) Upon the conclusion of purging under either of the conditions covered in (2) above, the procedure previously directed under Section 10 (a) shall be followed.

Operation of soot blowers may cause loss of ignition if done when the rating is too low. Soot blowers shall not be blown without a fire in the furnace, unless the furnace has been cooled down and is free from smoldering combustible material.

Oil Torches

(b) Permanent oil torches, if used should have a capacity of not less than three million Btu per hour and shall be installed according to the Standards for the Installation of Oil-Burning Equipment, as contained in National Fire Codes for Flammable Liquids, Gases, Chemicals, and Explosives and in N.B.F.U. Pamphlet No. 31. They are usually provided with spark ignition.

All torches should be designed for No. 1, 2, or 3 domestic fuel oil. Heavier oils should not be used without proper heating facilities.

Portable torches, except a kerosene swab, should have a capacity of not less than three million Btu per hour. Portable torches are usually ignited from a kerosene swab and should be completely removed from the furnace when not in use.

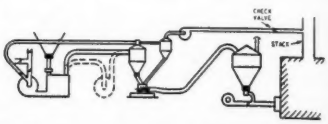


Fig. 5. Storage system with partial venting. A storage system is one in which the fuel is pulverized and stored in bins from which it is withdrawn through feeders as burned

Gas Torches

(c) Gas having not less than four hundred Btu per cu ft and at a pressure of not less than six inches of water shall be used for an ignition torch.

All permanent or portable gas torches should have a capacity of not less than three million Btu per hour and be so designed as to have stable ignition under the conditions. The gas supply line to the group of permanent torches of a boiler shall have two shut-off valves with a bleed-off to the atmosphere between them, and all three shall be interlocked so as to operate simultaneously. Portable gas torches should be completely removed from the furnace when not in use. Permanent gas torches are usually

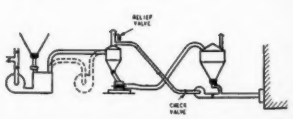


Fig. 6. Storage system with venting to primary air fan. When the vented air is used as primary air, as in this instance, each line shall have a fan, a check valve opening in the direction of flow from the furnace, and an operating vent to discharge the air not needed as primary air.

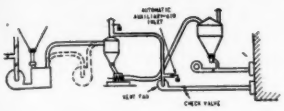


Fig. 7. Storage system with venting to the furnace. This vent shall deliver the air to a zone where the combustion is active. Also, a check valve shall be installed between the furnace and the fan and shall open only in the direction of flow

provided with spark ignition, portable torches usually ignited from a kerosene swab.

Pulverized-Fuel Torches

(d) Pulvertized fuel from a Storage System or from a small pulverizer of a direct-fired circulating system may be used to ignite larger pulverized-fuel burners. Each torch shall have a capacity of not less than three million Btu per hour, and the total capacity of all torches on a boiler should be adequate to bring the boiler up to pressure from the cold condition. These pulverized-coal torch-burners may be ignited with an adequate kerosene swab.

Interlocks and Starting Sequence

Failure of a forced-draft or induced-draft fan may set up a hazardous condition in the furnace, and the equipment shall be interlocked to stop promptly the flow of fuel to the burners if the air supply is appreciably reduced by the failure of a fan.

Typical arrangements are as follows:

(a) Direct-Fired System — Integral Drive on Pulverizer and Exhauster or Blower.

INTERLOCKS.
- Failure of induced-draft fan stops forced draft fan.
- Failure of forced-draft fan stops pulverizer and exhauster or blower.
- Failure of pulverizer and exhauster or blower stops raw-fuel feeder.
- Failure of raw-fuel feeder stops nothing.

STARTING SEQUENCE.
- Start induced-draft fan and partly open uptake damper.
- Start forced-draft fan and partly open secondary damper.
- Purge furnace for five minutes with an air flow equal to one-fourth that required for maximum output.
- Open valves to burners to be put in operation.
- Adjust air flow and draft.
- Light torches.
- Start pulverizer and exhauster or blower dampered down as required.
- Start raw-fuel feeder.
- Adjust pulverizer air control damper.

(b) Direct-Fired System — Separate drives on pulverizer and exhauster or blower. Exhauster or blower started before pulverizer and raw-fuel feeder.

INTERLOCKS.
- Failure of induced-draft fan stops forced draft fan.
- Failure of forced-draft fan stops exhauster or blower.
- Failure of exhauster or blower stops raw-fuel feeder.
- Failure of pulverizer stops raw-fuel feeder.
- Failure of raw-fuel feeder stops nothing.

STARTING SEQUENCE.
- Start induced-draft fan and partly open uptake damper.
- Start forced-draft fan and partly open secondary damper.
- Purge furnace for five minutes with an air flow equal to one-fourth that required for maximum output.
- Open valves to burners to put in operation.
- Adjust air flow and draft.
- Light torches.
- Start exhauster or blower dampered down as required.
- Start pulverizer.
- Start raw-fuel feeder.
- Adjust pulverized air control damper.

(c) Direct-Fired System — Separate drive on pulverizer and exhauster or blower. Exhauster or blower started after pulverizer and raw-fuel feeder.

INTERLOCKS.
- Failure of induced-draft fan stops forced draft fan.
- Failure of forced-draft fan stops exhauster or blower.
- Failure of exhauster or blower stops raw-fuel feeder.
- Failure of pulverizer stops raw-fuel feeder.
- Failure of raw-fuel feeder stops nothing.

STARTING SEQUENCE.
- Start induced-draft fan and partly open uptake damper.
- Start forced-draft fan and partly open secondary damper.
- Purge furnace for five minutes with an air flow equal to one-fourth that required for maximum output.
- Open valves to burners to be put in operation.
- Adjust air flow and draft.
- Light torches.
- Start pulverizer.
- Start raw-fuel feeder.
- Start exhauster or blower dampered down as required.
- Adjust pulverizer air control damper.

(d) Storage System. PULVERIZING SYSTEM (Separate Drive on Pulverizer and Exhauster or blower.)

INTERLOCKS.
- All pulverized-fuel bins full stops pump or conveyor.
- Failure of pump or conveyor stops vent fan.
- Failure of vent fan stops exhauster or blower.
- Failure of exhauster or blower stops raw-fuel feeder.
- Failure of pulverizer stops raw-fuel feeder.
- Failure of raw-fuel feeder stops nothing.

STARTING SEQUENCE.
- Start pump or conveyor.
- Start cyclone air lock.
- Start vent fan.
- Start exhauster or blower.
- Start pulverizer.
- Start raw-fuel feeder.

BURNING EQUIPMENT.

INTERLOCKS.
- Failure of induced-draft fan stops forced-draft fan.
- Failure of forced-draft fan stops the primary-air fan.
- Failure of primary-air fan stops the pulverized fuel-feeder.
- Failure of the pulverized-fuel feeder stops nothing.

STARTING SEQUENCE.
- Start induced-draft fan and partially open uptake damper.
- Start forced-draft fan and partially open secondary damper.
- Purge furnace for five minutes with an air flow equal to one-fourth that required for maximum output.
- Open valves to burners to be put in operation.
- Adjust air flow and draft.
- Light torches.
- Start primary-air blower and open primary-air control valve.
- Start pulverized-fuel feeder.

NOTE.—Variable speed couplings of the electrical type for varying speed of forced-draft or induced-draft fans driven by constant-speed motors should be interlocked with the motors.

Fig. 8. These sketches show a direct-fired pulverizer requiring no valves between pulverizer and burners

If automatic or lever-operated torches are installed, which can be electrically interlocked, they should be arranged so that the torches cannot be started until the furnace has been purged, as indicated by:

(1) The forced-draft and induced-

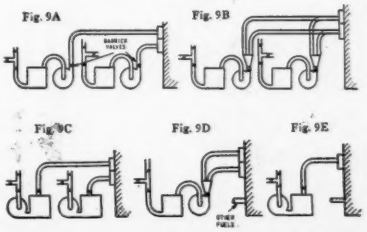


Fig. 9. Direct-fired pulverizer installations requiring barrier valves. The sketches A and B show two suction system pulverizers connected to the same furnace and having no valves in the individual burner lines. Sketch C shows two pressure-system pulverizers each having only one outlet connected to the same furnace. Fig. 9 D is a single suction-system pulverizer connected to one or more burners this can be fired by other fuels. Sketch E is a single pressure-system pulverizer connected to one burner in a furnace that can be fired by other fuels

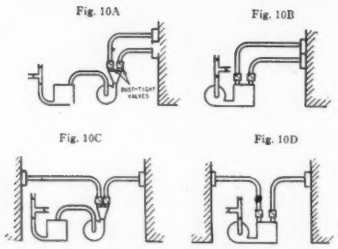


Fig. 10. Dust-tight valves shall be installed in each burner pipe at the exhauster or pulverizer outlet for one or more suction- or pressure-system pulverizers, each supplying two or more burners in the same furnace and designed to permit operation with one or more burners shut off. See A and B. The same is true of installations such as the ones shown in sketches C and D, where pulverizers are connected to more than one furnace at a time

draft fans being in operation, or, in addition,

(2) The closing of a time-delay relay which closes five minutes after the induced-draft fan has been started, or

(3) The closing of a purge-meter interlock which closes after an air flow through the furnace greater than one-fourth that required for maximum output has existed for five minutes.

With this arrangement, the pulverizers on Direct-Fired Systems or the pulverized-fuel feeders on Storage Systems should be arranged so that they cannot be started until the torches are in service.

(e) All motors driving fans, pulverizers, and feeders shall be equipped with low-voltage trips.

A flame detector, if used, should sound a warning bell or horn in case of flame failure.

Furnace Construction

While it is feasible to build the pulverizing system strong enough to withstand any possible explosion, it is not practical to build the furnace to withstand this internal pressure. Explosion vents on furnaces are not recommended as they have not proven to be of much advantage except as a warning, because it is impossible to make them large enough to relieve any possible explosion that might occur. Actually such doors may create a hazard and their use as vents is not recommended. A small indicator door in sight of the operator, which must be kept open when lighting off, and an explosion door in the upper part of the furnace will give warning of any hazardous condition.

Furnace walls, however, can be constructed strong enough to withstand small puffs producing a pressure of ¼ psi. It is recommended that all furnace walls be equipped with buckstays capable of withstanding a furnace pressure of 36 lb per sq ft with a deflection of the buckstays of not more than 1/360 of the span.

Extinguishing Fires in Pulverizers or Piping

The following operating procedure is outlined for information.

A fire in the pulverizer is usually indicated by an abnormal increase in temperature leaving the pulverizer. It may be caused by feeding burning fuel from the raw-fuel bin or by an accumulation of fuel in the pulverizer or piping in some position where it is not disturbed. In case of fire the manufacturer's recommendations for extinguishing the fire should be followed. A pulverizer fire may generally be extinguished by continuing operation using cold air to the pulverizer and increasing the raw-fuel feed as much as possible, as the atmosphere inside the pulverizer and burner piping is too rich in fuel to support active combustion. If the temperature continues to rise after fifteen minutes of increased raw-fuel feed using cold air only, the pulverizer should be shut down by closing the valves if installed in the pulverizer discharge lines, and by stopping the raw-fuel feed, air supply, and pulverizer, as quickly as possible in the order named, being sure that all openings are closed tightly. Steam, inert gas, carbon dioxide or water should then be introduced into the pulverizer through pipe connections provided for this purpose. Such connections shall be

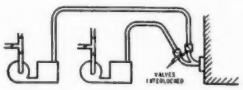


Fig. 11. Dust-tight valves also shall be installed at the burner when discharge pipes from separate exhausters or pulverizers are connected to the same burner nozzle

at least 1-in pipe. When water is used, the connection shall be so located and the water flow so regulated that no disturbance of the fuel in the pulverizer is created. After the pulverizer has cooled down, the doors may be safely opened and the interior thoroughly cleaned. In no case shall a compressed air jet be used, as there may still be some burning fuel.

In a storage system with recirculated air, steam or carbon dioxide should be circulated with the fan as quickly as possible and fresh air excluded from the system. This is best done by opening the vent to the atmosphere, thus extinguishing the fire in the pulverizer and venting any explosive gas to the atmosphere.

In case a fire occurs in a pulverized-fuel bin, the bin should be sealed against air infiltration and the pulverized fuel fed out and burned if possible. Steam and/or carbon dioxide should be admitted to the pulverized-fuel bin through connections provided in each pulverized-fuel bin. Such connections shall be at least 1-in. pipe.

Too much emphasis cannot be placed on the hazard of welding or burning on pulverized-coal equipment and lines which may be partly filled with pulverized coal. Definite rules cannot be written to cover all situations, but some suggestions are as follows:

Before cutting into a burner line which cannot be brushed out, the line should be thoroughly blown out and tested by tapping with a hammer to be sure it is empty before doing any burning or welding.

Before burning or welding inside a

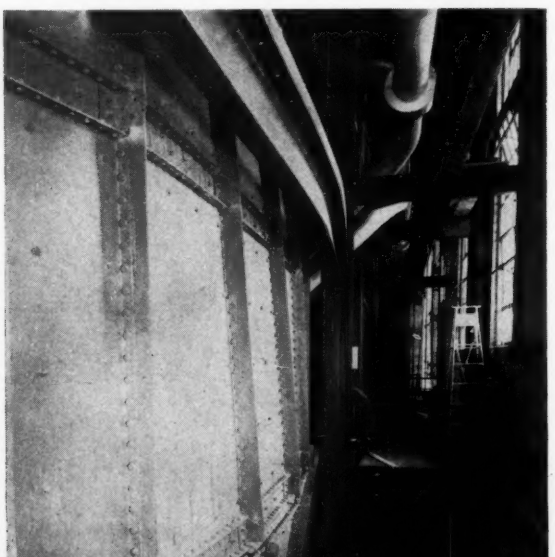


Fig. 12. This photograph dramatically illustrates the resulting damage when an explosion occurs inside a furnace. All four walls of the furnace were pushed out from 18 in. to 2 ft, opening large holes at the corners and loosening a number of water wall tubes. Three of the boiler operators who were on duty at the time were injured slightly. Property damage was estimated at $100,000. (Photo, Courtesy *The Locomotive*, official publication, The Hartford Steam Boiler Inspection and Insurance Co.)

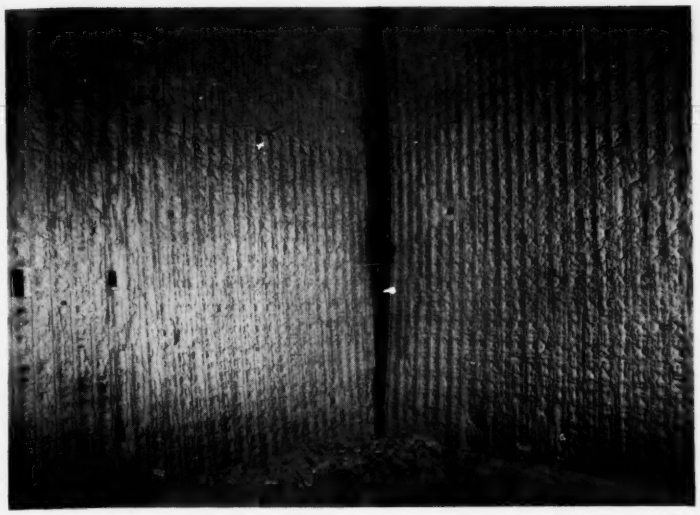


Fig. 13. Another photograph of the same explosion. The top of the boiler setting was broken, and the steel casings for the economizer and the preheater were bulged (see above) with sufficient force to bend several adjacent 10 and 20 in. I beams. (Photo, courtesy *The Locomotive*, official publication, The Hartford Steam Boiler Inspection and Insurance Co.

pulverizer, cyclone, or dust collector, the interior should be brushed free of coal and wetted burlap placed beneath the burning or welding operation.

Pulverizer Outlet Temperature

Means shall be provided to measure the temperature of the fuel-air mixture leaving the pulverizer. There is no fixed value of maximum operating temperature leaving the pulverizers. Temperatures of 150 to 180 F are commonly used and will be best adapted to the majority of installations. Where the demands for early ignition are very exacting, it is desirable to have the absolute minimum of moisture in the pulverized fuel, and temperatures above 200 F may be used.

Operating Instructions

(a) Complete instructions for the operation and maintenance of pulverizing and burning equipment on each different type of boiler or furnace to which they are applied should be prepared by the operating department of the user with the aid of the equipment manufacturers and revised to be complete after all adjustments are made to the equipment. The instructions should be studied carefully by all operators and one copy kept at each operator's station at all times and be available for review by a representative of the inspection department having jurisdiction.

(b) Before placing the equipment in regular service, all installations shall be thoroughly inspected and tested to check the operation of all equipment including the torches, interlocks, and all other controls. During this time all adjustments shall be properly made, and fixed within the required limits, so as to avoid changes in settings.

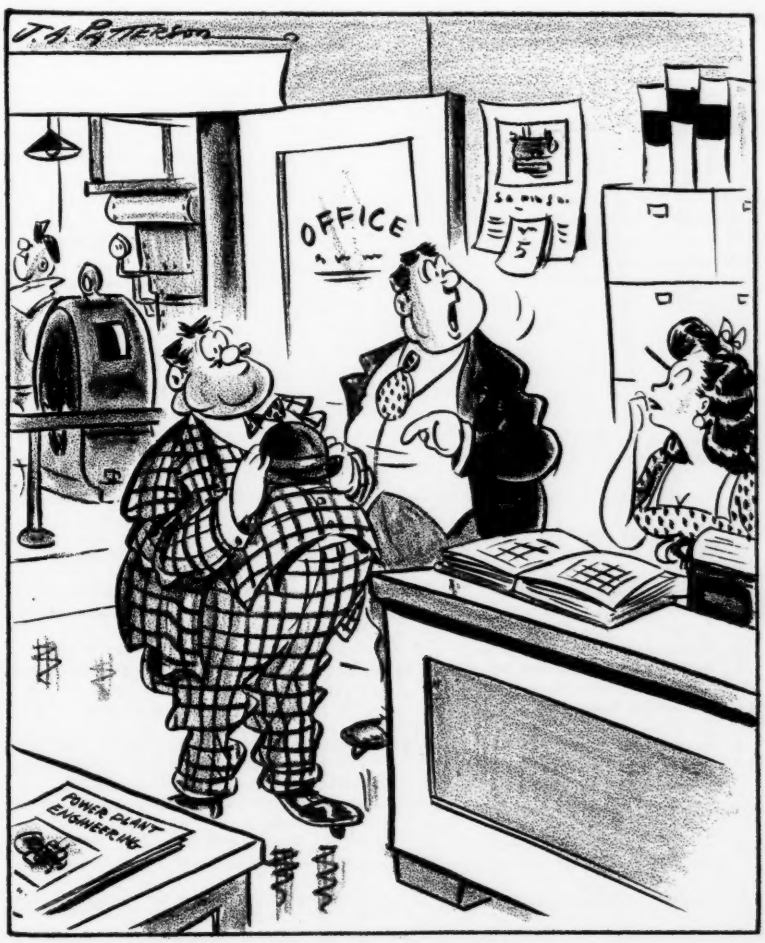
Editor's Note—This article is taken, in part, from the recently-published booklet "Installation of Pulverized Fuel Systems," a pamphlet prepared by the National Board of Fire Underwriters. Single copies of this booklet may be obtained, free of charge, by writing the Board at 222 West Adams St., Chicago 6, Ill. Ask for Bulletin 60A. This booklet contains complete definitions of all terms used in the text of the standards, and gives complete directions for arrangements of the various types of pulverized fuel systems.

MOTOR BEARING GOOD FOR 101 YEARS

By Thomas Trail

AFTER ELEVEN YEARS of continuous severe service, an induction motor was recently disassembled and the bearing on one end of the motor showed a wear of less than 15/10,000 of an inch, due to intelligent maintenance and proper lubrication. It was estimated that at this rate of wear the bearing would not require replacement for at least 90 years.

Regular maintenance, and especially proper lubrication, can prolong the useful life of any motor. Another example is a 7½ hp motor that operates 22 machine tools in a machine shop near Boston. This motor is a veteran of two wars with the same bearings. The original bearings have stood up under more than five billion revolutions of the motor shaft.



"Mr. Flbstivotchinkosky is the man I hired for the boiler room—get his John Henry on the books"

Refrigeration System Emergencies . . . Causes, Prevention, Cure

Causes of emergencies and focal points of their origin . . . Precautionary fire measures in refrigeration . . . Pressure vessel explosion . . . Temperature rise increases pressure disproportionately . . . Ten pointers for prevention of pressure vessel explosions . . . Causes of breakdown of compressors . . . Danger of unclean or unsuitable lubricating oils . . . Ammonia causes saponification; water causes emulsification . . . Most common emergency is a serious ammonia leak . . . Completely evacuate refrigerant from condensers, receivers before welding . . . Immediate action in case of serious leak on high pressure side of system . . . Causes of intersystem leakage . . . Cause of compressor priming and its effects . . . Preventing shortage of condenser water . . . Keep extra fan and repair parts handy . . . Restriction or stoppage of brine circulation . . . Operator controls some of many causes of power failure

By GEORGE HOLMAN *

IN AN EXTENSIVE refrigeration system an emergency may arise at any moment. It may stem from one or more of several causes. The effects vary from the discomfitting to the disastrous. Financial loss due to down time, damage to goods, equipment and building, serious injury to personnel and possible loss of life commonly result. Specific causes of emergency conditions range upward from power failure to serious leakage of refrigerant, explosion of a pressure vessel, and fire. In diminishing degree of importance common causes of emergencies and the focal points from which they arise are:

CAUSE OF EMERGENCY	LOCATION
1. Fire.	Building, motors, oil supply, refrigerant (in some instances), goods.
2. Pressure vessel explosion.	Condenser, liquid receiver, evaporator, accumulator, compressor, generator, absorber, etc., (of absorption systems).
3. Breakdown of compressor.	Compressor.
4. Emulsification of lubricating oil; breakdown or contamination of such oil.	Compressor, expansion valves, stop valves, evaporator, condenser.
5. Refrigerant leakage to atmosphere. (Serious)	Any part of the refrigerant circuit.
6. Serious intersystem leakage of refrigerant.	Expansion valves, safety valves, line stop valves, manifold stop valves, safety heads, machine suction and discharge valves.
7. Priming of compressor.	Expansion valve, compressor, heat exchanger accumulator.
8. Condensing water failure.	Supply, supply pump, or line, filter, scale trap, recirculating pump, spray headers, distributors.
9. Secondary refrigerant failure.	Tank leakage, agitator, circulating pump or fan, evaporator, brine pipes, baffles.
10. Power failure.	Motor, engine, transformers , transmission lines, switches, fuses, controls, belts, couplings, etc.

Analysis of this list of causes of emergencies and the focal points of their origin and outbreak show that Nos. 2-7 inclusive directly concern the primary circuit of the refrigerant. The other four, however, though external to the primary system, can just as effectively interrupt or slow down the refrigeration process; more effectively, in the case of fire. The conditions which create these emergencies, with their more common precautions, may be detailed as follows:

Fire

Of all the hazards to which an operating refrigeration system is subjected, fire is by far the most serious. Fire in the building in which the system is located may carry with it not only loss of the building and goods in storage; there is also likelihood of loss of the refrigerant charge, possible explosion of one or more of the pressure vessels and irreparable damage to part or all of the equipment.

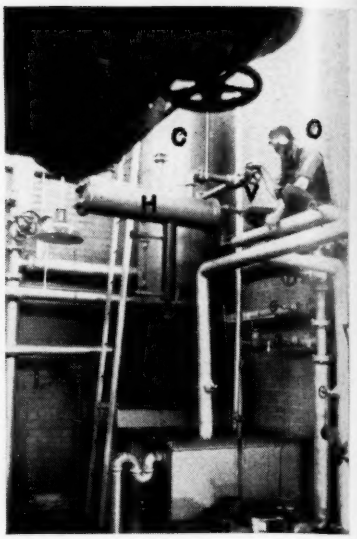


Fig. 1. Refrigeration valves may or may not be handily located. Here a leak has developed at the bonnet of the oil blowdown valve X. In order to remove the valve bonnet for a new gasket, the hot vapor line, into which it connects, must be pumped out. This can be done by closing the valve I in the liquid outlet of the shell-and-tube condenser C and a stop line in the equalizer line (not visible). A quicker pumpout, excluding the condenser, is possible however, by closing the angle stop valve V in the line between the water heater H and the condenser. To reach this valve the operator (at O wearing gas mask) is compelled to climb up on pipes of the water system

Because cold storage plants contain few or no windows, a fire may smolder for hours before breaking out in visible flames. Being unnoticed in its initial stages, a cold storage fire is often out of control upon its discovery.

As in other buildings, the best way to meet an emergency due to fire in a refrigeration plant is by precautionary measures. Oil should be stored in a prepared fireproof place. Electric motors should be protected from overload and overheating. All electric wiring should be in underwriter-approved conduit, made moisture-proof by packing and gasket seals at switches, cover plates and outlets. Piles of waste materials should not be allowed to accumulate, since spontaneous ignition may occur in them, even in low temperature surroundings.

Other means of combating the fire hazard are use of a gas mask with canister charged both for smoke and am-

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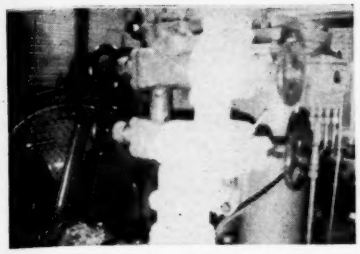


Fig. 2. Five of the various emergencies described in this article have an immediate relationship to the compressor. This piece of equipment has numerous places for outward leakage of refrigerant. Most intersystem leakage takes place here; contaminated oil enters here; dangerous priming takes place here as does most mechanical failure

monia, the keeping of proper extinguishers in all places subject to fires, use of fireproof materials where possible and regular inspections of both building and fire-fighting equipment.

Pressure Vessel Explosion

It should be borne well in mind that ammonia, the most extensively used refrigerant, is a toxic, alkaline and highly volatile substance under high pressure, and restrained only by metal walls sometimes less than 0.125 in. thick. It should be also remembered that an increase in temperature of a few degrees above its normal condensing temperature increases its pressure greatly out of proportion. A temperature rise from 100 F to 125 F, for example, will raise the pressure from 200 psi to 300 psi, or 4 psi per degree average.

If the containing vessel also contains air or other non-condensible gases, the pressure due to temperature rise is still further increased, possibly beyond the safe working pressure which, for ammonia, is generally accepted to be less than 250 psi. Rupture of such vessel as a liquid receiver, shell-and-tube condenser, or shell type brine cooler is second only to fire in its disatrous effects.. More so, even, than in case of fire, an emergency due to explosion of a pressure vessel can be met satisfactorily only by precautionary measures. Here are some preventive pointers:

(a) Ascertain the maximum safe working pressure of every pressure vessel of a refrigeration system, and never permit pressure in it to rise above this point.

(b) Never operate such a vessel under refrigerant pressure greater than its most recent test under air pressure, even if the safe working pressure, as computed or given by the manufacturer, is higher.

(c) Ascertain from standard codes the permissible pressure on such a vessel for the refrigerant being used, as for unfired pressure vessels, and never permit the pressure in it to rise above this point. Where the working pressure, as given in codes and laws, found by computation or determined by test, differs, the lowest figure should be the one to use.

(d) Each shell type pressure vessel should be equipped with at least one safety valve, distinct to itself. (See Code). If the vessel is a part of the high pressure side of the system, this relief valve should be the only valve in a pipe line discharging into a part of the low pressure side of the system. If the vessel is normally a part of the low pressure side of the system, as a brine cooler, the line should extend to atmosphere at a safe distance outside the plant. (In some instances discharge of ammonia into sufficient water supply is required by law or code).

(e) Each compressor should be equipped with its own safety valve.

(f) Never permit the temperature of the refrigerant vapor discharged from the compressor to rise abnormally high. High discharge temperature may cause both refrigerant and compressor lubricating oil to decompose, with evolution of non-condensible gases. These gases raise condenser pressure above the pressure of the refrigerant pressure, and increase the discharge temperature still more. If there is much air in the condenser, a highly explosive mixture of air, vaporized oil and these gases may be formed at or near their flash point. A disastrous explosion may ensue.

(g) Never close all inlet-outlet valves of a liquid receiver unless a vapor space shows in the gage glass. A few degrees rise in temperature of a liquid having no vapor space into which to expand causes a very great increase in pressure on the vessel walls. Violent rupture, accelerated by the volatile nature of the enclosed refrigerant, may result.

(h) Never suddenly release the pressure on any pressure vessel.

(i) Open and close all refrigerant valves slowly.

(j) Guard against any rapid temperature changes.

Breakdown of Compressor

Potentially as dangerous as a fire or explosion, the latter of which it resembles, mechanical failure of an operating compressor may result in complete loss of the refrigerant charge, injury or death of personnel, costly shutdown of the plant and probable necessary replacement of the compression unit. Breaking down of a compressor may be caused by:

(a) Attempting to run the compressor with discharge valve closed.

(b) Explosion caused by breakdown of the refrigerant and recombination of its constituents, with or without air, oil or oil derivatives, under high compression temperatures.

(c) Attempting to compress liquid refrigerant or lubricating oil.

(d) Gumming of moving compressor parts by sludge or unsuitable oil.

(e) Direct mechanical failure, as broken piston rings, broken or loose suction valves, valve cage screws, wrist pins, burned out bearings, hot cylinder walls, etc.

Much trouble may result from charging an unsuitable or unclean lubricating oil into the enclosed crankcase, or the cylinders, of a compressor. In most refrigeration systems, and especially those charged with ammonia, oil containing water in perceptible quantities is an unclean oil, just as those containing animals or vegetable oils. Ammonia is a strong alkali. As such, it rapidly forms a soap with any but the pure mineral oils. Small amounts of water, even in pure mineral oil, will cause the oil to emulsify, and seriously reduce its lubricating value. If the oil contains animal or vegetable matter, the whole of the oil charged by pump or lubricator may be transformed into sludge.

Once this sludge has been formed, it is usually carried throughout the circuit of the refrigerant. Pockets of it will form in scale traps, evaporators, condensers and at pipe valves, unions and other fittings. Pistons and cylinder walls may heat, and bearings seize at cranks, crossheads and shaft. Automatic expansion devices stop up. In extreme cases it may be necessary to scald out the system with steam, or clean it while cold with gasoline, kerosene or other oil solvent.

The best solution, as in other emergencies, is precaution. In an ammonia system none but a pure mineral oil of approved characteristics, such as high flash point and low congealing temperature, should be used. Special precautions are necessary to keep moisture out of the oil, especially in cases where external lubricators are used on the compressor.

Serious Refrigerant Leakage to Atmosphere

Though seldom costly or dangerous, the most common and apparent emergency is a heavy ammonia leak. Although a leak from the high pressure side is seldom worse than a leak from the low pressure side, a liquid leak is noticeably worse than a vapor leak. A

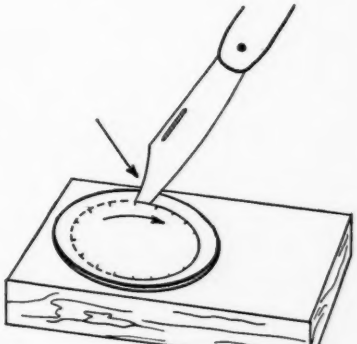


Fig. 3. Very frequently an entire refrigeration system is kept idle until a gasket can be found or cut. In an emergency a small flange or valve bonnet gasket may be cut down as shown, by the "step-back" method. This prevents tearing of asbestos gasket material; gasket is marked off with compasses or dividers and is then cut by punching on a wood block. Steps must be less than width of the knife blade near the point. The cutting edge is always toward the cut. If the material is thick or tough, or the knife is dull, two passes around a cut may be necessary

leak is also more troublesome if it occurs in an enclosed space, as a cold storage room.

Repair of most leaks requires no system preparation. Packing glands of a compressor may be tightened while the machine is operating. Also, cover plate nuts may be tightened on their studs without any preparation, if caution and skill are used. Leaks at valve stem packing anywhere, screw-bonnet valves anywhere, and flange-bonnet valves retaining vapor only may be tightened, with caution, at any time. However, no flange or flange-bonnet of a valve retaining liquid ammonia should be tightened under pressure, except with the greatest caution and in the gravest emergency. If possible without interrupting operations for too long, a flange under high pressure, especially a two-bolt flange, or retaining liquid under low pressure, should be isolated before attempting to take up to stop a leak.

Should they leak, threaded joints of pipes must be unscrewed, cleaned and replaced with a sealant of glycerin-bound litharge paste. Never try to tighten a litharge-sealed threaded joint more than fifteen minutes after it has been installed, and always allow fifteen minutes for setting before turning pressure upon it. In most instances repair of a threaded pipe joint requires a pumpdown of that part of system.

Leaking tube ends of shell-type condensers, water heaters and brine coolers may be resealed, in many instances, by re-rolling after the refrigerant has been exhausted from the vessel.

No attempt should be made to weld any pressure vessel, or connection to it, such as a liquid receiver or shell type condenser, until the refrigerant has been completely evacuated from it and all carry over oil and sludge blown out with steam. To try to weld one of these vessels without a thorough cleaning out of all residue oil is to invite an explosion, even with all connecting valves open to atmosphere. When preparing for welding, treat all refrigerator pressure vessels exactly as if they were oil barrels to be welded. If it takes place, an explosion of oil vapor in a liquid receiver may be even more disastrous than if it took place in a barrel.

If a leak occurs on the evaporative side of the system, it is necessary for a pumpdown only to cut off the liquid supply at the master stop valve and continue operation until the suction gage pointer falls to zero. In a multiple evaporator system the pumpdown may be speeded up by isolating those parts of the system which do not need to be pumped out.

Even under high vacuum, liquid refrigerant will lie in a heavily frosted evaporator for some time. To allow this liquid to escape by a too hasty opening of the system may result in serious injury such as flesh burns and increase in ammonia concentration in the air. Before opening the system, scrape off the frost at the lowest part of the pipe and apply the stick test with wetted finger. If the finger sticks to the metal allow more time for the liquid to evaporate.

If a very serious leak of liquid occurs on the high pressure side of the system, quick action may be necessary. Opening the by-pass valve on the compressor manifold, whether or not the compressor can be stopped, immediately lowers condenser pressure by permitting compressed vapor to flow back into the evaporators. Opening the pumpout valve accelerates this flow. As soon as the pressures have equalized, the suction and discharge valves should be closed. Operation of the compressor then begins the pumpout of the condenser. To keep a reverse cycle from being set up by feedback of liquid from the evaporators, it is necessary with all manual and some types of automatic valves to close the master valve as well.

When reversing vapor flow at the compressor extreme caution is necessary, especially in systems where liquid refrigerant lies in the condenser or oil trap. Upon rapid pressure drop such liquid, sometimes carrying oil with it, may boil over into the cylinders and cause the safety heads to lift. The better practice is to throttle the pumpout valve at first, then open it gradually.

When a system is opened for repairs, stop valves frequently fail to hold tightly. Also oil and sludge contain more ammonia, when under pressure, which they give off when the system is opened. From these sources the amount of ammonia in an already foul atmosphere may be increased. A gas mask with ammonia-solvent canister should be kept handy, even if not worn, in an ammonia-fouled atmosphere.

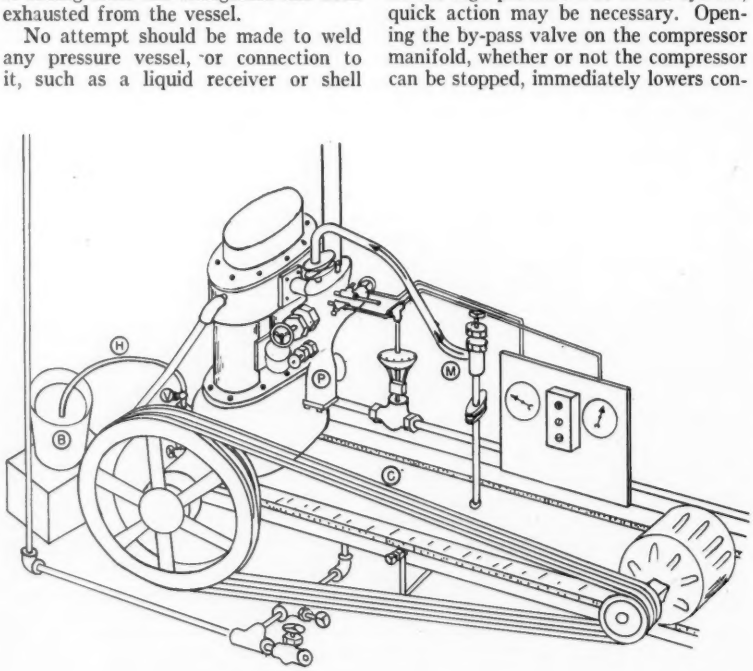


Fig. 4. When purging air from the condenser C, a service mechanic opened the cock V too quickly. The hose slipped out of the purge bucket B and struck the mechanic across the face. H is the purge hose. P is pumpout valve which must be opened for purging through the crankcase to the oil gage glass connections. M is the hot vapor line valve. Arrows show direction of flow of foul gases through this valve, hot vapor line, manifold and compressor to the purging hose. Procedure not recommended, but sometimes useful and economical of time when condenser pressure is low

Intersystem Leakage

Leakage of refrigerant from one part of the system to another reaches the emergency stage only when excessive. It occurs at poorly seating expansion and line stop valves, manifold stop valves, safety valves, safety heads, piston rings, machine suction valves and machine discharge valves. Any leakage at the manifold or compressor will permit vapor to leak back and condense in the evaporators during the off cycle. In systems with small volume evaporators, this may cause the compressor to prime when starting. The same danger may arise if an expansion valve or float regulator leaks during the off cycle.

In medium or low temperature service the leakage of an expansion device is betrayed by a frost trace, provided the suction pressure does not rise too high. Leakage through the compressor or a manifold valve may be determined by closing the main return valve and stopping the compressor. A rise indicated by the suction gage then denotes leakage at the compressor. The more rapid the rise, the more serious the leak. The specific point of leakage may sometimes be determined by sound. Generally, the compressor must be opened for inspection.

Priming of Compressor

A frost trace at the manifold of a compressor operating at medium evaporative pressures signifies "expanding back" of liquid refrigerant. It is caused by an expansion valve admitting too much liquid during the operating cycle, or by leakage at the expansion valve and/or compressor during the off cycle. Or, retardation of brine or air circula-

tion may be the cause, as when fans, agitator, or circulating pump stops, direct evaporators become too heavily frosted, brine beginning to "sludge up," due to weak concentration or low temperature or accumulations of oil in the evaporators. The effect, however, is at the compressor, damage to which is certain if to much liquid enters the cylinders.

Besides the frost trace, warning of priming occurs in a rapid fall in temperature of the vapor discharged from the compressor. The cylinder heads cool off. Poppet type valves may click a few times before the safety heads lift.

If frost and cold discharge vapor are the only warnings, the expansion valve should be closed. If automatic expansion is used, a stop valve in the liquid line should be closed. If machine valves have begun to rattle or click, a high speed compressor should be stopped, the suction throttled and the compressor again started. The evaporative system should be pumped down until the cause of the flooding can be ascertained.

If there is a heat-exchanger accumulator in the system, its low pressure space will fill with liquid in any extreme case of flooding. When restoring refrigerant circulation after a pumpdown made necessary by flooding, the liquid valve must be opened slowly and the manifold suction valve kept throttled. Hot liquid under high pressure surging through the heat exchanger coil will cause violent boiling of the carryover liquid from the evaporators lying in the low pressure space. Slugs of liquid may carry on into the compressor, with damaging or perhaps disastrous results.

Condensing Water Failure

Lack of ample condensing water creates a condition usually prevented from becoming disastrous by the operator and by safety valves, high pressure cutouts and other safety devices. However, the emergency will continue until an ample supply of cool water is distributed over the condenser surface.

Failure of the water supply may be at the source, as at reservoirs and wells, by stoppage or breaking of the water mains, pump failure, or unequal distribution of the available supply. A high wind blowing water out of an atmospheric cooling tower may cause a marked rise in condenser pressure.

To prevent a water shortage, a secondary supply to an exhaustible source should be provided. Essential equipment, such as recirculating water pumps, fans and their driving motors should be installed in duplicate, given proper service and breakable parts kept in stock.

Secondary Refrigerant Failure

While some heat is transferred from cooling or freezing goods to direct expansion evaporators by radiation, by far the greater amount is carried by air as a secondary fluid. In direct expansion systems and in ice making brine is the secondary refrigerant. Unrestricted circulation of these fluids is essential to capacity operation.

With forced circulation, direct expansion evaporators, stoppage of the fan reduces capacity to a small fraction of normal. For this reason an extra fan and repair parts should be kept available. In some instances circulation through finned type evaporators is restricted by frost, as also occurs in natural circulation evaporators. Defrosting is necessary when the air stream can no longer pass freely between the pipes of the evaporator.

Restriction or stoppage of brine circulation is caused by failure of the circulating pump, or agitator, by sludging up, or freezing, of low concentration brine, or by failure of tank baffles. The proper solution is to keep the brine concentration high and the circulating machine in good repair.

Power Failure

Power failure may take place at couplings, belts, engine, motor, switch, fuses, overload relay, high pressure cutout, controller, transmission, transformers, or the original source of power. All but the last three of these are under control of the plant operator. Each must be kept in good repair, since failure of any one may, and generally does, result in complete stoppage of the refrigeration process.

The prime requisite of a coupling is that it transmit the power positively yet flexibly. Flexibility is necessary to absorb starting shock, and to prevent vibration of the compressor from reaching the driving machine.

Belt failure may be prevented by maintaining it at proper tension, by use of a good dressing and by keeping pulleys clean and in proper alignment. V-belts should not be run over pulleys with misshapen grooves. Such belts should not slip at starting. If belts are old, a new set, not partial set, should be kept available.

Contactor and switch points should be kept clean by file or emery cloth, and ample replacements of fuse cartridges and fillers kept on hand.

Emergencies may arise in the best managed and best installed plants. The best prevention and the best solution is an intelligent, skillful and ALERT operator.

"Old Man Accident" Using Old Tricks to Trip Up New Victims !

Present trend toward more accidents may be blamed on workers relaxing after the busy wartime production era, but the author believes the increase is caused by workers following unsafe working procedures which are allowed to go unchecked until they cause serious accidents

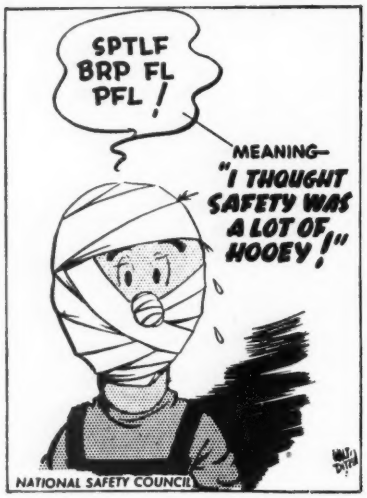
By JOHN G. REYNOLDS

IF THE trend toward more accidents, and the sudden flareup of carelessness is allowed to ramble along unchecked, the box-car figures that will pop out of the adding machines when this year wheezes out will establish a new high for America's annual tribute to carelessness. Right now, matter-of-fact statisticians, on the receiving end of colored cards representing fellow citizens who have been accidentally killed or injured, know that a certain reprobate tagged with the monicker of Old Man Accident is having the time of his lusty life.

Since the war's end, workers apparently have relaxed and become more gullible for Old Man Accident's stale but effective tricks than they were during the high pressure war days when the steam was on and they were busy producing the stuff that won the war.

In our own industry, accident reports are folowing the national trend by increasing in number. Here are a few accidents picked at random, and you won't find a new one in the bunch. The same bone breakers and skull crushers were happening in 1910, 1920, 1930, 1940, and now in 1947 they are cropping up again to cause the usual run of expense, pain, suffering and even death.

(1) Two employees forgot all about handlines and the man on the ground flipped a wrench up through the air to his partner on the pole. Sure, sometimes



it works like a charm, but in this case the luckless guy on the pole missed the wrench but the wrench didn't miss him. The result; a lacerated upper and lower lid on the right eye; rupture of the iris with marked irregularity of the pupil and contusion of the eyeball, and 10 days disability.

(2) A repairman moved a rolling ladder failing to notice that a soldering iron had been left on the top step. Unluckily, the iron wasn't glued down and it fell striking and seriously burning the employee. I don't know exactly how many safety rules have been written on the dangers of leaving tools on ladders, but I know there have been a few hundred safety bulletins prepared which plainly show the dangers of such practice.

(3) In another case an office employee, while working at her desk, opened a lower drawer. She failed to close the drawer and later, when she arose to go to another department, struck the drawer and fell. This is an old one but it trips up hundreds of office workers every year.

(4) A few years ago we were quite accustomed to receiving reports of poles breaking and throwing an employee to the ground. Then this type of accident slowed down—but here's a brand new one that happened a few days ago.

The employee had climbed the pole and had just put himself in position when the pole broke and threw him to the ground. Investigation showed that the pole had not been tested to see if it was sufficiently strong to hold the employee's weight. Yet in the garage through which the employee passed every morning were two large safety bulletins. One plainly stated—"Test every pole with a pike or bar before climbing!" The other stated—"If there's any doubt about a pole's safety, it should be guyed four ways before climbing."

(5) Another recent report describes an accident that occurred when a pulley fell off the messenger and struck an employee on the head cracking his skull. A safety manual issued by the injured worker's company carries an entire page warning employees to "Keep away from underneath an employee working on a pole!"

Five more old ones, but they are cropping up to injure our men and women and they represent only a few. Men are tripping over loose objects left on floors, stairs and platforms. Wet, dirty and greasy floors are causing broken bones and cracked skulls. Workers are pulling their insides out lifting weights incorrectly. Body belts are snapping; unsafe rubber gloves are being used and found unsafe only when they are removed from the badly burnt hands of some employee who forgot to test them; goggles are being worn on the forehead and flying missiles are blinding unprotected eyes; matches instead of flashlights are being used in dark hallways and basements, etc.

Accidents are usually the result of unsafe habits developed by the workman. Often an injury is the result of an unsafe act and the injured person was hurt because he was in the habit of doing the job the unsafe way. The workman commits the unsafe act while he is performing a routine task usually because his supervisor has permitted him to do it unsafely over and over. Some foreman or supervisor could have prevented the accident if he had demanded that the workman always do his work the safe way.

We can mutter to ourselves about workers relaxing, walking about a room filled to the rafters with safety bulletins and safety equipment and walking out to have an accident that he has been warned bout by hundreds of methods. But in the final analysis it's plain to see that freedom from injury comes from safe working habits that are usually drilled into a man by his foreman or supervisor.

REDUCE MOISTURE content of steam. Live-steam purifiers can reduce moisture from 5 per cent to less than 1 per cent in steam headers resulting in drier and hotter steam. Recover engine exhaust by removing entrained lubricating oil with exhaust steam purifiers.

RETURN ALL condensate to the boiler. To run condensate to the sewer is sheer waste of heat and fuel. Return condensate to boiler at highest possible temperature and pressure. Avoid loss of flash steam in open heaters.

"WE CAN GIVE 'EM PLENTY OF FORMER EMPLOYERS, BUT WHO'LL WE GIVE FER REFERENCES?"
IT PAYS TO WORK SAFELY!
NATIONAL SAFETY COUNCIL

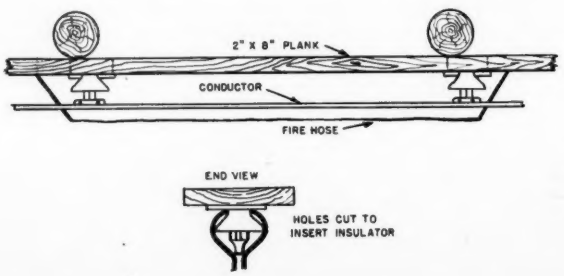
PRACTICAL HINTS AND KINKS

OLD FIRE HOSE SHIELDS FOR TROLLEY WIRE

By P. C. Ziemke

PRACTICALLY all large plants have old fire hose in storage that can serve for many additional years as a trolley safeguard when properly fastened. The sketch indicates a typical installation where a wood overhead structure at a pedestrian crossing is protected against contact by persons carrying long metal objects such as pipes, rods or like materials. The natural tendency of the hose is close up at the slit edge after passage of the trolley wheel, so that the wire is almost as completely insulated as if wrapped in the regulation high-tension tubing used by linemen.

The installation we used the hose on carried 300 v d c and the wire had a



Ziemke shows how old fire hose can be used to shield trolley wire at a pedestrian crossing

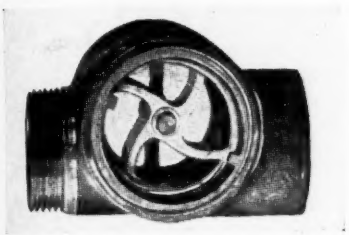
uniform clearance of 7 ft above the track, hence the need for a guard at any point where men might readily make contact. Slitting one edge with a good jack knife and nailing the closed edge to the overhead planking is all the labor required to mount this guard; and it will outlast many such installations made of light lumber.

GLASS-ENCLOSED INDICATOR SHOWS COOLANT FLOW

By Paul C. Ziemke

IN MANY PLANTS the conservation of water is a prime consideration, so that such installations as coolant water for air compressors or such machinery must be piped into a closed circuit that will permit secondary use of the water or direct it through a cooling tower.

Under such conditions, the conventional open-type discharge to the sewer system is, of course, ruled out and the operator must be provided with an enclosed type unit that will be readily visible from any convenient distance in the engine room. Illustrated here is



Visible flow indicator as described by Ziemke

the device that is used with success on the coolant system of a 100-hp Diesel unit used as standby service to a rural lighting plant. It is so located that it is readily visible; and, to further improve the installation, a shielded 25-watt lamp is attached from the side for night illumination. The pipe line being 1½ in. in diameter, the vane spins at speeds that are easily checked by the operator without eyestrain.

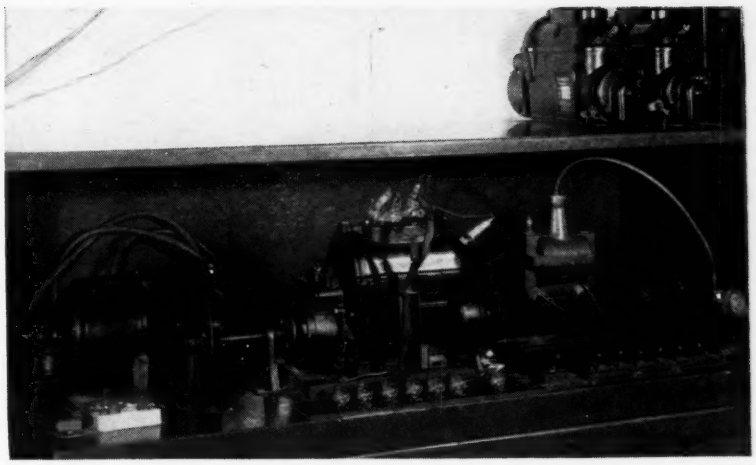


Fig. 2. View of magneto tester set up and ready for operation

HOW TO MAKE A MAGNETO TESTER

By Edwin W. Lindop

THE TESTING MACHINE described in this article was made from scrap parts picked up around the plant. We find it so useful that we think others might like to make a similar machine.

We have four Worthington gas engines of 375 hp each at Dominguez Water Corp., Dominguez, Calif. They are ignited by Scintilla Bendix LA6 low-voltage magnetos, connected to Scintilla high-voltage ignition coils to raise voltage to the spark plugs. Each engine uses two magnetos and twelve high tension coils.

We keep three spare magnetos on hand. The tester enables us to keep them checked and adjusted, ready for immediate use.

The magneto test machine is driven by a ⅛-hp motor, which is geared to drive the magneto at the speed it is driven on the engine—in our case, half engine speed. The machine is wired so we can switch each magneto terminal through a 3-watt, 18/24-v miniature lamp to ground. By switching these lamps we can check the sequence and timing of firing. By switching through the high-tension coil and spark gap we can check the intensity of the spark or check a high tension coil.

The photos show the machine, and the diagram shows wiring. This tester has saved us time and money, as it is now unnecessary for magnetos to go out for repair or adjustment.

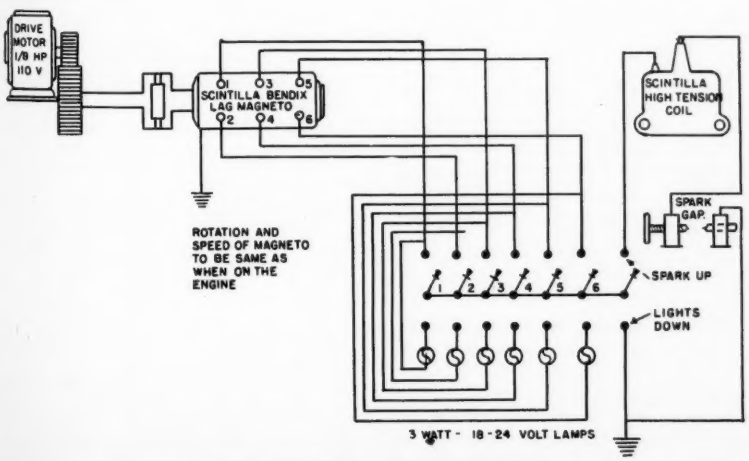

DRIVE MOTOR 1/8 HP 110 V
SCINTILLA BENDIX LAG MAGNETO
SCINTILLA HIGH TENSION COIL
SPARK GAP
ROTATION AND SPEED OF MAGNETO TO BE SAME AS WHEN ON THE ENGINE
SPARK UP
LIGHTS DOWN
3 WATT - 18-24 VOLT LAMPS

Fig. 1. Wiring diagram of magneto tester

SOAP STOPS GASOLINE LEAKS

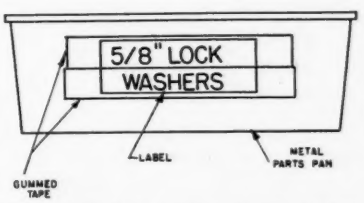
By J. R. Kennedy

ORDINARY leaks of gasoline, tractor fuel, and perhaps other hydrocarbons, from tanks, drums, or other containers having small leak-openings, can be stopped by rubbing ordinary laundry soap vigorously over the opening, causing it to stick. At first thought, you would think the gasoline or other hydrocarbon would dissolve the soap; but it does not. This is often used as an emergency measure, to serve until one has time to make a more permanent repair by soldering, welding, or riveting.

LABELS FOR METAL CONTAINERS

By Thomas Trail

WHERE metal containers such as boxes, pans, etc. are used for keeping small parts, it is sometimes difficult to keep labels on them for identifying the contents. A simple remedy consists in



Trail shows how transparent gummed tape holds labels on metal containers

placing strips of gummed cellulose sealing tape over the labels. The tape will stick firmly to the container and, since the tape is transparent, the writing or printing on the label will be visible.

LETTERS AND COMMENTS

HOW GAS ENGINE WAS IMPROVED

By J. R. Kennedy

BY MAKING the following changes I have improved the service rendered by a large gas engine in a small plant.

It was originally hopper-cooled, but I removed the hopper, bolted on a plate, and with the help of two barrels and some pipe, changed the cooling system to a circulating system. This prevented boiling over during long runs.

When using kerosene or tractor fuel in this engine, it was necessary to mix a small amount of water with the fuel to prevent pounding, presumably caused by excess heat. This was accomplished by means of a valve equipped with a sight-feed glass, and a pipe leading to the hopper—and later to the plate above referred to. But there was irregularity in the feeding of water in both cases, due to boiling and fluctuation in pressure after the engine warmed up. This fluctuation during the warming-up process made constant attention necessary to prevent excess pounding and even stoppage. This trouble was overcome by shifting the water-feeding pipe to a can fastened on the side of the engine; this can was full of still water of even temperature. This eliminated the fluctuation produced by boiling water and also eliminated the necessity of making frequent adjustments, formerly required.

When water got into the cylinder of this engine in bad priming—or when some of the boys stopped the engine without thinking to close the water-feeding valve—we found it almost impossible to start it again due to inability to "blow" the water out through the prime cock, which was located high up. On occasions we had to remove the igniter, poke a rag on a wire through the hole, and mop out the water. This trouble was overcome by putting a drain pipe in the cylinder and equipping it with a drain valve. In doing this it was necessary to drill a hole through both the outer and inner walls of the cylinder, using a pipe with enough threads to screw through the outer wall and then screw its way on into the inner cylinder wall. Onto the lower end of this pipe a drain valve was screwed.

When I had baffling igniter and magneto trouble, I found it necessary to remove the piston and check the firing in order to trace the trouble to its source. I feared that the igniter springs were improperly adjusted. The igniter fired (or produced a spark) irregularly and erratically, sometimes making a fat spark, and at other times none, upon turning the engine and observing through the open cylinder.

However, when I disassembled the magneto, I found the feed wire from the armature had become unsoldered from the brass armature ring or distributor. Also the ring was loose and floating; in other words, it was not rotating in unison with the armature, as it was not tight enough. After wedging the ring in position and resoldering the wire, the magneto gave no further trouble.

Missing cylinders in air-started engines are sometimes caused by corroded jumpers. This may cause flooding, and raw fuel exhausted into mufflers may result in explosions, which burst the mufflers. Some of this trouble may be avoided by using resin-core solder instead of acid-core solder in soldering jumper connections. In general, it may be said that acid-core solder may lead to corrosion; while resin-core may inhibit or entirely prevent it.

Lagging fuel pumps can sometimes be helped by placing a wedge in the cam groove in *some* cam-operated pumps.

MORE POWER HOUSE ERRORS

THE LETTER by H. B. McDermid, Power House Errors, on page 107 of the December issue, reminded me of a few in my own experience.

No. 1 Experience. The resistance grids used when starting a rotary converter on the d-c side were mounted on a concrete wall, and covered with a sheet metal casing. The mechanic (?) who assembled the grids used an excessively long bolt. Instead of cutting the bolt off flush at the nut with a hacksaw and burring the end over, he left it as it was and mounted the casing, connecting the ground wire in the process. The end of the bolt reached to ⅛ in. from the casing.

One night there was some trouble on the system, following which the second operator on watch smelled smoke and started looking for its origin. In the course of his search, he placed his hand on the top of the casing, which pressed it down until it made contact with the bolt end. The consequence was a flash that burned away part of the casing and sent the second operator to the doctor with three badly-burned fingers.

Besides the matter of a bolt too long and a casing too close to the grids on all sides, there were two other errors in the location of this grid: (a) It was located in the oil room, which made it a fire and explosion hazard. (b) The oil room was used as a workroom by the maintenance crew for certain overhauling jobs, and the location of this casing was such that there was always the possibility of a workman laying tools or work parts on it.

The chief operator knew of these risks and was continually cautioning the workmen not to lay anything on the casing, although he didn't know about the bolt until the above accident occurred. Also, he had asked several times to have the grid removed to a safer location, or else have a larger casing, with a strong angle-iron frame built around it.

No. 2 Experience. A power company had removed the machinery from an old power house, and set up a small substation in part of the former engine room.

At the time, it was not expected that the power demand in this area would be very high, so low first cost was the main consideration. As time went on, however, an industrial area built up adjacent to the plant, while a residence load developed near by. To meet the increasing demand, additional equipment was added from time to time as needed, but no definite plan was followed so that the plant became a hodge-podge of equipment of miscellaneous sizes, types, and by several different manufacturers. When things started to happen, the operator on watch had to do plenty of thinking to make certain that he was doing the right thing at the right time.

There were two motor driven centrifugal pumps supplying cooling water to the transformers. One day, one of the pumps developed trouble, and it was decided to remove the pump, motor, bed-plate and all, and send it to the

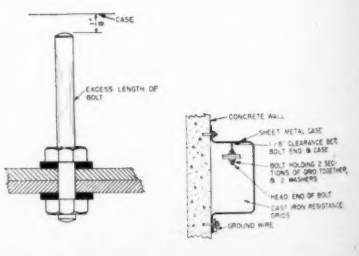


Fig. 1. Sketch by Livingston showing how grid-holding bolt was installed too long and led to serious short-circuit

company's machine shop, about 5 miles distant, for a complete overhauling.

The following day, the other pump developed similar trouble. The operator on watch at the time was a relief man not regularly stationed at this plant, but supposed to be thoroughly familiar with the plant—although he proved not to be. Instead of immediately calling the chief operator, who was in another plant nearby, or a general utility man who was working in a shop in the plant grounds, the operator tried to handle the situation himself.

In a shed a short distance from the plant building, there was a triplex pump operated by an 80-hp motor. This pump was primarily installed as a high-pressure fire pump, but was connected to a manifold so that it could be used as a general service pump. It had a by-pass with a spring-loaded relief valve to prevent the pressure going above 60 psi when used as a general service pump, with a hand lever to block the relief valve closed when used as a fire pump.

The operator cut the fire pump into service in place of the little 10-hp centrifugal, but did not release the block on the relief valve.

The utility man saw a geyser suddenly shoot out of the ground, and started for the substation on the run to see if anything had gone wrong there. As he passed the pump house, he heard the triplex pump groaning, and noticed water spurting out of the piston rod packings; so he immediately stopped the pump. On entering the station, he found the relief operator with both feet on the desk, reading and unconscious that anything was wrong. Fortunately for everyone concerned, a pipe had burst outside the plant and relieved the pressure, instead of a cooling coil inside the transformer casing.

No. 3 Experience. A consulting engineer was called in by the manager of a large office building to try and eliminate disagreeable vibration set up by an engine in the basement. The manager explained that, during the depression, a salesman for a machinery firm had sold him an engine on the promise that as it was necessary for him to install boilers for steam heating, he could add the generating plant at a moderate additional cost, use the exhaust steam for heating, and save the cost of purchased power. The machinery firm had several complete sets, consisting of engine, a-c generator, and exciter, in stock at the time and on account of the depression it would sell them at a greatly reduced price. Furthermore, the salesman would have his own men do the job of installing which would save the fee of a consulting engineer.

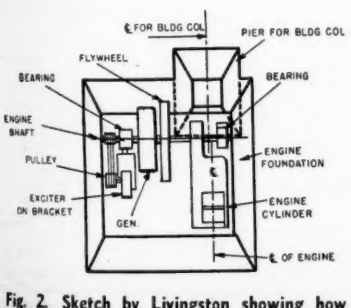


Fig. 2. Sketch by Livingston showing how installation of engine foundation led to severe building vibration

An examination of the engine room showed that it was in a very deep basement, with a tall steel column almost in the center, resting on a pyramidal concrete pier. Here's what the consulting engineer found.

The concrete engine foundation had been poured so that the column pier was partly encased in the engine foundation. The exciter was mounted on a pivoted bracket, so that its weight served as a belt tightener. The engine was a uniflow, with two poppet valves operated by a single eccentric controlled by a fly-wheel governor. It was noticed that the exciter made a jump every revolution, indicating a high angular advance on one stroke of the piston, but a much lesser one on the return stroke. A further examination showed that the engine had a capacity of double the heaviest load that it would ever be required to carry and most of the time it was much less than that. The adjustment of the valve gear was such that at light loads the engine ran almost single acting. The centerline of the piston rod was almost through the vertical centerline of the building column. The pulsations of the reciprocating parts set up vibrations in the building column that were transmitted to the frame of the building. Clearly this was not any fault of the engine itself but was due to extremely bad installation and operation.

In justice to the engine manufacturer it should be pointed out that another company took advantage of depression prices to purchase several of the same type engines, and had very satisfactory results. In their case, however, they purchased the engines on the floor of the warehouse under a rigid guarantee and had a competent engineer of their own selection design and supervise the installation.

HOWARD T. LIVINGSTON
Los Angeles, Calif.

THE VERY FIRST ATOM BOMB

I WOULDN'T KNOW, or have any way of knowing, how many congratulatory letters you will receive from your "hosts of admirers" initiated by *Front Lines* of the November issue. Not one of those epistles, however, will be written with greater sincerity than this letter of mine. I always said you were tops, Andy. Hail to the Chief! !

Some time ago I submitted a story about my Dad's old Cider Mill to a magazine published in nearby Dublin, *The Yankee*. Did you ever hear of it? You will, for I asked the editor to mail you a copy when the story was published. When I gave him the order, I told him that you had been at Bikini and that you had written "the best articles, by far, on Tests Abel and Baker." I am certainly pleased to know that, in so doing, I stole a march on *Industrial Marketing* magazine.

That Silver Plaque looks mighty good but the engaging grin on A.W.K.'s map looks better to me. I've always wondered how you looked. Now I know. I'll bet that's just the way you grinned when you slipped in "one of our good subscribers" at the masthead of *Practical Engineer*.

Subsequent to the story I sent to *Yankee*, and at the editor's request, I submitted to him several old-time Hard Cider Recipes. One of them I called the very First Atom Bomb. I warned him never to drink it but to keep it to blast rocks or blow out stumps. It occurs to me that it could be developed, with not much change, to put a 1400-psi boiler on the line from cold water in 45 sec flat.

If you should be interested in this very *First* Atom Bomb, developed many years before Tests Abel and Baker. Here's the recipe. Personally, I was never able to get beyond Test Abel. Pardon the "corn."

Hard Cider—(hard as Pharoah's heart —or harder) 1 gal.
6 fresh eggs. Beat 'em up and beat 'em in.
1 qt.—and here is where the fission starts—of good wine.
Suspend the wine over the cider with some sort of remote control. Pull the string or press the button and run for your life. DON'T return to view the damage until all danger from radiation is definitely over—say about two weeks.

Some time ago, in the *Boston Herald*, a storm raged about an inoffensive baker or caterer who had constructed a great cake as part of the festivities to welcome or honor some high officer of some branch of the Service. Surmounting this cake was a replica of Test Baker. This was considered by a clergyman, who sponsored the protest, to be in inexcusably poor taste. I hope my feeble attempt at humor doesn't strike you the same way.

ARTHUR H. PARKER
Peterborough, N.H.

POWER PLANT ENGINEERING—50 YEARS AGO

READING this article about the power plant of yesteryear in the December issue, it is interesting to see how far this field has changed in the operation and equipment. The principles are the same, but there are better and quicker ways of getting power. It is interesting, too, to see how saving Btu's could mean so much in dollars to buy new and more up-to-date equipment.

As for the operating personnel of many years back, there are all types today as there were 50 years ago who have their faults as well as good points. They had their fun 50 years ago, as well as their headaches. Today there is the National Association of Power Engineers and there many other associations throughout this land who want the

engineer to share his knowledge and experience with the new men coming into this field. If these older men with their wealth of knowledge will get into a local association and share their knowledge with the men of today and engineers of tomorrow, everybody will benefit.

One point in the article seemed to stand out: I heard a discussion of it only a few weeks back. An engineer said: "When I was a boy, my Dad was an engineer and many people looked up to him as though he were someone special. I often heard other men remark, 'Yes, he's an Engineer!' The engineers in those days did occupy a position in society and were accorded respect and, as you mention, a degree of envy. Their knowledge did give them a sort of prestige."

Maybe we who take this engineering seriously were born too soon or too late. Anyway, notice what Brother McDowell did to look after the interests of the guests. (December, page 88)

The bond between engineers today, I believe, is not what it used to be. There are so many diversions for the engineers today, that the bond is gradually breaking away. To get the engineers together to attend an educational meeting or a power show, or even for a visitation to any new power plant to see its modern equipment, is getting to be quite a problem.

But getting back to your article, it was a grand piece of work to get this data and pass it on to the younger men today; many an old timer will get a good laugh as he thinks of the past and the present.

My wife, my little girl and myself were looking at that picture on page 88, and my daughter remarked, "I love that hat!"

WILLIAM T. MULLEN
Philadelphia, Pa.

Questions And Answers

Question No. 372

WHAT IS VALVE CAM SETTING FOR MARINE DIESEL?

WHAT ANGLE will the cams for the ahead fuel valve and the astern fuel valve occupy on a 2-cycle marine Diesel engine, with the following timing angles:—valve opens 5 degrees before top center and closes 40 degrees after top center? What would the angles be on a 4-cycle engine?
Salem, N.J. J.M.

Question No. 373

HOW CAN HE GET MORE CALCULATORS?

A FEW DAYS ago I saw the Ohm's law calculator offered on page 64, February issue; sent my quarter and got one. Since I have to do quite a bit of calculating of resistances at times, I find this calculator of the highest value for this special purpose. It's a great time-saver and I recommend it highly. I notice also a frequency calculator on page 56, March issue, and I think I will get that too.

In fact, I think I'd like to get quite a few of the special calculators offered to engineers by various manufacturers. If I can judge by my experience with the Ohm's law calculator, devices of this kind should save a lot of time in making quick estimates and tentative calculations about a lot of power plant problems.

But—how can I find out what kinds of calculators are available and where to get them? Do you have a list of them, with prices?
Chicago, Ill. A.A.

Editor's Note—If enough readers are interested in this, we'll be glad to make such a list available.

Question No. 374

WHAT ARE DUTIES OF WATCH ENGINEER, FIREMAN, OILER?

WILL Q & A readers give me their comments on this:

What are the duties of—
a. A watch engineer
b. A fireman
c. An oiler

Rhode Island F.P.

Editor's Note—This, you may think, is absurd. Surely you know, and every other engineer knows, what they are. But—just try writing them down!

It seems clear that this engineer is trying to find out if there is any general statement of these duties that would define the jobs and responsibilities of these men in *any* power plant. Does the law define them? The labor unions? Personnel departments? Engineers themselves?

Any engineer should be able to define those duties as they apply to his own plant. He may already have them written down, either for his own reference or for distribution to his staff or for his training program. We can define them ourselves in what we think is a satisfactory way. The U. S. Army and Navy can and do define the duties and responsibilities of all types of personnel. Let's have Q & A readers' ideas of how they should be defined for the power engineering business.

Question No. 375

CAN FURTHER ADJUSTMENTS BE MADE ON THIS ENGINE?

HERE ARE three indicator cards, taken from a Hamilton Corliss engine, 20 in. by 42 in., 79-rpm double-eccentric. The rings, valves and cylinders are in good condition. When the engine was on dead center there was no lead. I am having trouble because this engine will not pull the load. It operates beaters and jordans in a paper mill. Figure 1 was taken before the adjustments were made.

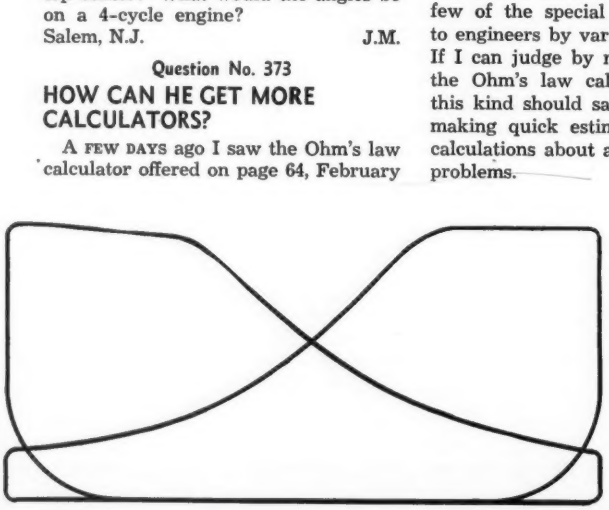


Fig. 1. Card from 20 by 42-in. Corliss before adjustments were made to give lead and increase cut off. Figs. 1, 2 and 3 actual size, traced direct from original cards. Throttle steam pressure—150 psi gage. Exhaust pressure—10 psig. Speed—79 rpm. Indicator spring—80

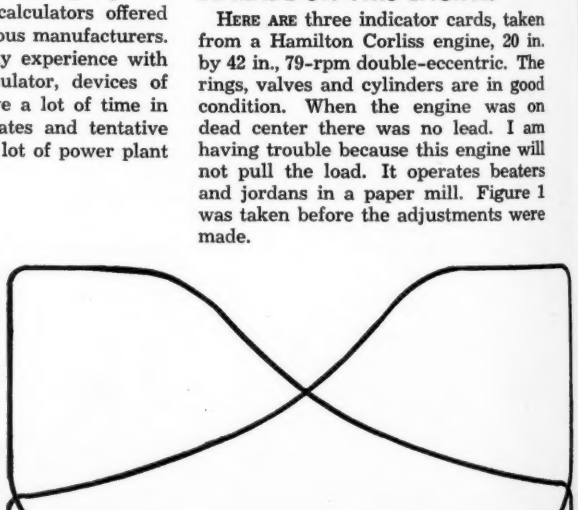


Fig. 2. Card from engine after engine was adjusted for 1/32 lead and increased cut off

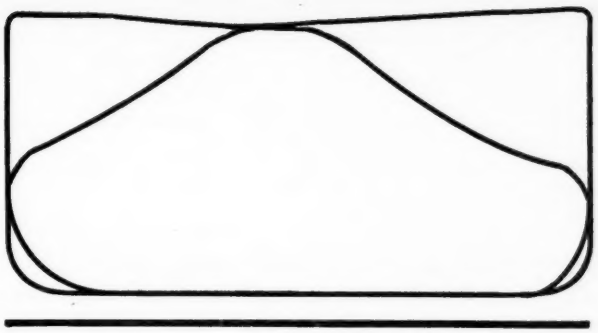


Fig. 3. Card from engine at full load after adjustment

Figures 2 and 3 were taken after adjustments were made to get 1/32 in. lead at admission and the cutoff on governor cam was increased.

Please advise me if any other adjustments could or should be made.

Monroe, Mich. O.H.D.

Answer No. 328

WHY GREATER PRESSURE DROP WITH LIVE STEAM?

Don't Mix Authorities, says Yavitch

IN THE discussion by Mr. Septor under this question in the November, 1946 issue, he tells us that he got the enthalpy of the exhaust steam from the Mollier chart. The latter does not have lines of constant specific volumes. He then resorted to steam tables and read the correct value of specific volume at 10 per cent moisture. Dividing an approximate value by a correct value was one thing that caused trouble in his calculations.

The Mollier Chart is an enthalpy-entropy plane. Lines of constant values of pressure, temperature, moisture, enthalpy and entropy are very definite. However, the constant specific volume lines do not plot at all well on this form of chart.

Hence Dr. Mollier was forced to use another diagram of pressure-enthalpy coordinates. On this diagram the volume lines are satisfactory, but the constant-entropy lines do not give good intersections with the other lines.

Warning, Mr. Practical Engineer! Never take values from more than one authority and use them in the same calculations. The values given by any one authority are generally fairly consistent among themselves, though the absolute values may be in error. The final results of calculations, each consistently made with the data of a single authority, will differ little among themselves.

If one, like Mr. Septor, has a problem involving enthalpy and specific volume and does not wish to resort to steam tables he should then use the *Enthalpy-Volume Chart* prepared by Prof. Frank O. Ellenwood of Cornell University, published in 1914.

On this chart, the ordinates are specific enthalpies and the abscissae specific volumes. Now if we take the line of 17 lb and find the point where this line intersects the 10 or 12 per cent moisture line, we find the approximate value of the enthalpy: simultaneously, the value of the volume at the same approximate conditions. This value of the volume will have the same approximation as that of the enthalpy. The quotient will, of necessity, be a correct answer.

Y. YAVITCH

Philadelphia, Pa.

Answer No. 336

WHAT'S WRONG IN THIS REFRIGERATION PLANT?

Bachmann Tells How One Plant Solved the Problem

THE COMPREHENSIVE suggestions of Messrs. Harvey and Holman, in the October 1946 issue, are very good, but will C.O.S.'s employer be inclined to consider such a major alteration as suggested by Mr. Holman, which entails a lengthy shut down? Definitely, I am in accord with the proposal to form two distinct systems if possible.

Inasmuch as C.O.S. inherited the problem, consider his statement, "we get the temperature down to -5 deg to -20 deg, the latter temperature being a rarity." This indicates that evaporator —compressor—condenser capacity are not balanced properly and therefore the plant is operated most inefficiently.

Here is the method we used to overcome a similar problem and practically eliminate the operating difficulties in a plant that operated four 60-ton compressors at zero gage back pressure with three different temperatures (-20 deg, + 6 deg, + 30 deg) as one system.

1. Arrange to install constant-pressure regulating valve in the suction line of the + 30 deg cooler evaporators.

2. Arrange to install *automatic* (not thermostatic) expansion valves of *sufficient capacity* in the four 20-deg freezers.

3. Arrange compressor sequence operation according to loads.

4. Arrange stable head pressure via condensing water control.

As to the heat exchanger, it appears that C.O.S. has sufficient compressor capacity, therefore omit it. Instead, install an automatic purger, which will enable him to dispose of the foul air most effectively while the plant is in operation.

Such a purger was described in the May 1945 issue in discussing Question No 289. The installation of separators for automatic purging in systems operating below atmospheric condition or below zero pounds pressure would pay for itself out of savings in no time.

CARL BACHMANN

Astoria, L.I., N.Y.

Answer No. 343

HE WANTS DEFINITIONS OF UTILITY TERMS

Here Are Some, But Always Subject to Change

ON THE QUESTION of meaning of the terms firm capacity, relay capacity and others, in the August and December 1946 issues, here are more comments from an electrical engineer in a large utility organization. This organization not only designs its own sytsems but supervises their operation.

Our contributor points out that men in their contract and operating departments are wary of set definitions of these terms. They change with "wind and weather," use, abuse and actual operating experience. However, he continues, those he has asked in his own organization find no fault "at present" with the following definitions. "Tomorrow there may be an East wind." That seems to be the general opinion of utility men about these terms.

Contract Definitions

Firm Capacity—Capacity of a system, or for purchased power, always available.

Relay Capacity—(Or Relayed Capacity)—Includes all power (or capacity) transferred from one system through a third (or other) system (the third or other system being merely the transfer or relay system in providing transmitting facilities with no added generating capacity beyound normal supply) through the use of its transmitting facilities.

Reserve Short-Term Capacity—Capacity available only under emergency conditions (emergency conditions may or must be specified with qualifying elements).

Unreserved Short-Term Capacity—(also referred to as "dump power")—Capacity available at unscheduled intervals and for indefinite periods due to conditions unpredictable and not known in advance. (This applies particularly to hydro systems during excessive stream flow periods and sometimes to steam plants where excess generating capacity is installed and the operating load factor can be improved through additional "dump-power" load during the system "off-peak" period; or during some period of seasonal load decrease).

Answer No. 349

HOW TELL WHETHER COAL OR OIL IS CHEAPER TO BURN?

Emerson Calculates Fuel Cost

THE MOST important point to consider in this question is the cost per thousand lbs of steam generated. I feel this is the basis of the whole subject. Figuring the costs on a purely fuel basis, the oil is to be preferred to coal for the following reasons.

H.G.C.'s coal costs $10.50 per ton and

has a heat value of 14,300 Btu per lb. Using these figures and assuming that 8 lb of water are evaporated per lb of fuel, it will require 1000 ÷ 8 = 125 lb of coal per 1000 lb of steam. The coal at $10.50 per ton will cost 0.525 cents per lb. Then, 125 × 0.525 = 65.625 cents per 1000 lb of steam, the fuel cost with coal.

Bunker C fuel oil will average about 145,000 Btu per gallon. At this rate a gallon of it will be the equivalent of 10.139 lb of coal. Then, 125 ÷ 10.139 = 12.33 gal of oil. The oil is at the rate of $52 per thousand gallons or 5.2 cents per gallon. Then 5.2 × 12.33 = 64.116 cents per 1000 lb of steam, the fuel cost of oil. There is a difference of 1.51 cents per 1000 lb steam in favor of oil.

Another method is to find out how many Btu's can be purchased for one dollar. Coal; (14,300 Btu × 2000 lb) ÷ $10.50 = 2,723,809 Btu per dollar. Oil; (145,000 Btu × 1000 gal) ÷ $52 = 2,788,460 Btu. This is a difference of 64,651 Btu, more per dollar in favor of oil. Compare this with coal and note it will take 64,651 ÷ 14,300 = 4.52 lb more coal to equal a given amount of oil. This will cost 2.37 cents more than the oil for a given amount of energy.

Both cases favor oil and are nearly the same. This saving is not much per 1000 lb of steam but on larger amounts will add up in a year. If we figure the saving of 1.51 cents per 1000 lb in favor of oil on the basis of a 10-hr day, evaporation of 9000 lb steam per hr, then 9 × 1.51 = 13.59 cents per hour saved. 13.59 × 10 = $1.36 per day × 24 days per month = 31.64 per month × 12 month, $379.68 per year.

It will be well to remember this is based on the evaporation of 8 lb of water per lb of fuel. There have been tests on oil where the evaporation has been 15 lb per lb of fuel oil. At this rate the savings will be even greater than the above.

Considering the storage of coal, handling space required, ashes to be removed, etc. These are not required with oil. The cost will increase with each rise in fuel costs but I think oil is the cheaper of the two. Over week ends a coal fire is banked, coal is used with no return; whereas oil can be so installed that very little is wasted for this period.

CHESTER V. EMERSON

West Roxbury, Mass.

Answer No. 352

CAN HE USE THE EARTH TO REDUCE TEMPERATURE OF COOLING WATER?

Must Use Correct Heat Transfer Rate

TO TRANSFER heat successfully by conduction, the conducting material must be thin. The figure for heat transfer given by L.F.C. is misleading, for most readers would assume that heat would be transferred as shown in Fig. 1.

Study of actual conditions would show that heat transfer by conduction takes place as shown in Fig. 2. The

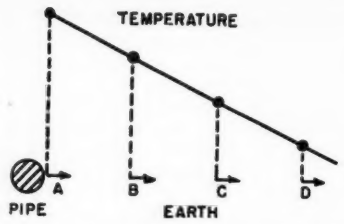


Fig. 1. Sketch by Heidecker showing graphically how heat does NOT flow by conduction

figure 0.9 Btu would be all right between A and B, Fig. 2, but could not be used between B and C; a much lower figure like 0.5 Btu would apply for this section. The value from C to D would again be much lower, maybe 0.3 Btu.

In the practical application of this problem we are faced with a condition called a "steady state" flow. This means that although 0.9 Btu was the

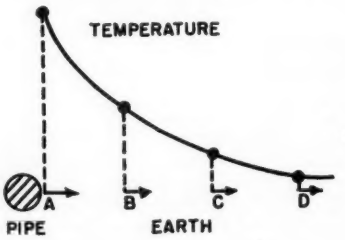


Fig. 2. Sketch by Heidecker illustrating correct way of showing how heat DOES flow by conduction

rate of heat transfer as given by L.F.C., actually only 0.3 Btu would flow and this rate would govern the rate at which the heat passed from A to B with constant temperature differentials.

WALTER HEIDECKER

Chicago, Ill.

Answer No. 358

HOW MUCH CHLORINE FOR SWIMMING POOL WATER?

IN THE January issue, G.B. stated that the algae in his swimming pool had gotten ahead of him and asked how much chlorine he should feed to get rid of it, also whether he should use copper sulfate in conjunction with the chlorine.

In the February issue, we gave some comments on the general practice in using these chemicals to purify swimming pool water and indicated sources of information. Here are more detailed comments from readers, confirming our general instructions.

Grant Has Been in the Same Boat; Gives Detailed Solution to Problem

IN REGARD to your problem of chlorination, you should feed chlorine to give from 0.2 to 0.5 ppm residual in the water. To do this will take about 1 ounce of chlorine to 10,000 gal. of water or 6 pounds per million gallons.

You have a pool capacity of 50,116 gal and a pump capacity of 4620 gpm. This should give you about an 11 hour turnover in which to feed about 5 oz of chlorine. This should make you feed about ½ oz per hour. This is a theoretical figure and after trial can be increased or decreased as the case might be.

If the chlorine is introduced as the water goes into the filter you will be able to use a higher content, because the filter bed will take out some. However, if the chlorine is introduced after the filtered water leaves the filter and goes to the pool, these figures should be close. If the pool is used entirely by males for swimming, the lower residual figure should take care of the bacterial content in good shape. If it is used entirely by females, use the higher residual figure.

If your chlorinator is one of the popular makes the manufacturer will include in the instruction book a curve and instructions as to the rate of feed. This will tell you how to set the rate of feed of the equipment. The only trouble that may be experienced is that the equipment might not feed at so low a setting. In this case, set it to the lowest rate of feed and cut down on feeding time.

Obtain a chlorine test set and make frequent tests. There is a small set made by W. A. Taylor & Co. for swimming pools which will give both chlorine and alkalinity. These are very accurate and do a nice job.

Do not let your residual climb above the 0.5 ppm as you might cause some burning of the eyes of the swimmers. Keep a few notes on the performance of your equipment, dosages and results. Then by comparison, in a few weeks, you will have the whole situation under control.

If you are feeding the powder form of chlorine such as HTH or Perchloron, these contain about 70 per cent available chlorine. Other forms of bleaching compounds contain from 24 to 35 per cent. This might be of some help in figuring solutions.

To convert ppm to lb per thousand gallons, multiply by factor of 0.0083 or the long way—

ppm = (lb of chlorine × 1,000,000) ÷ (Gal of water × 8.33)

If a bleach containing 33⅓ per cent available chlorine is used, it will take 3 lb of the chemical to give 1 pound of chlorine. To give 1 ppm per 50,000 gal will take about 0.0083 × 50 = 0.4150 lb. This in turn will have to be multiplied by three which will give 1.23 lb of the 33⅓ per cent bleach.

Solutions to feed are most satisfactory at about the 2 per cent in strength. Here is a handy formula for figuring volume of a solution: Lb of chemical ÷ 0.02 × 8.33 = gallons. The 0.02 can be substituted for any percentage required.

As to the use of copper sulphate, or blue vitriol, to treat the algae, in some cases this is a good and only application; and in other cases a failure, depending on the kind of algae you have. In most cases the application of chlorine

will take care of the algae. A continuous 0.5-ppm residual will kill almost any of the algae that the writer has encountered. If not, try boosting the residual to 1.0 ppm.

Try this over a period of several weeks. The day of the week that the pool is closed for cleaning use the 1 ppm dosage. This in turn will dissipate itself over night. Algae spores have a regrowth in from five to seven days so attention must be given. Chlorine is better to use for this because it does not take so much extra work, nor increased chemical cost and, if an overdose is used, will clarify itself in a short time by dissipation.

If chlorine fails to do the job, a 0.5 or 1.0 dosage of copper sulphate may be tried. This should be used as an intermittent treatment, with the pool not in use. The sides should be scrubbed down with mops and sufficient time allowed for the chemical to work out before swimming is resumed.

I sincerely hope this is of some help on your problem, and if I can be of further assistance, please write. I understand, having been in the same position myself.

Danville, Illinois — JOHN A. GRANT

Answer No. 360

CAN HE GET MORE POWER BY BALANCING UP 3-PHASE LIGHTING CIRCUITS?

HE NEEDS a small additional amount of electric power, said E.M.D. in the January issue and thinks he can get it from his own generator, without purchasing it from outside, by a re-arrangement of his lighting circuits and transformers. He showed his present connections and a couple of ideas he has for improving the circuits to save power now being used by un-balanced circuits.

Grounded Arrangement Will Do It, Says von Dannenberg

THE QUESTION is basically one of fundamental requirements for 3-phase generator operation to obtain the most satisfactory results. To obtain the full rated capacity of the unit without overloading any phase, it becomes necessary to balance the load so it will be the same for each phase. There may be some deviation allowable, but the nameplate rating must always be assumed correct unless the manufacturer informs user otherwise. While the generator efficiency is based upon a balanced load, any unbalance may have an adverse effect in causing poorer voltage regulation. Also, since the maximum current per phase is limited to a definite value, an appreciable unbalance will in turn lead to a reduction in the total output of the unit.

The transformer shown in your Fig. 1, January, connected to two lines, one phase, is indicated 10 kva or $10/_{25}$ or 40 per cent of the total phase capacity of the unit itself, assuming 10 kva load. So, without allowance for load phase differences of the respective loads, the total 3-phase generator capacity would be reduced if so connected.

For your Fig. 3 each transformer low voltage 3-wire system would have to be operated separately, due to the phase differences, because short circuits would result if connected in a group as shown.

The system indicated in Fig. 4 is a satisfactory one; the neutrals of the 110/220-v circuits should be grounded as indicated. Many states have mandatory laws requiring grounding of the neutral for human protection with a maximum of 150 v to ground.

A more efficient system is indicated herewith as a revision of Fig. 4; through the use of auto-transformers wound for 220 v with a middle tap, it is possible to obtain a low voltage 110/220-v, 3-wire system. A common system grounding point is indicated by a transformer bank connected in star on the 220-v side with the neutral grounded and enclosed delta on the other side; this arrangement will limit the voltage of the system to ground to $230 \div \sqrt{3}$ or 127 v. This system results in lower losses and better regulation for the 1-phase loads.

It is also possible to obtain, for 220 v, air cooled transformer units which can be installed at the feed point to any low voltage distribution panel or distributing center. Small auto-transformers can be used, permitting closer balancing for the system. These transformers are a standard product. While objection may be raised against having a grounded 220-v system, actual experience indicates the need for keeping the insulation of such a system in a satisfactory condition. The capacity of the grounding bank can be made low, usually 10 to 25 per cent of lighting load capacity.

Brooklyn, N. Y. — C. O. VON DANNENBERG

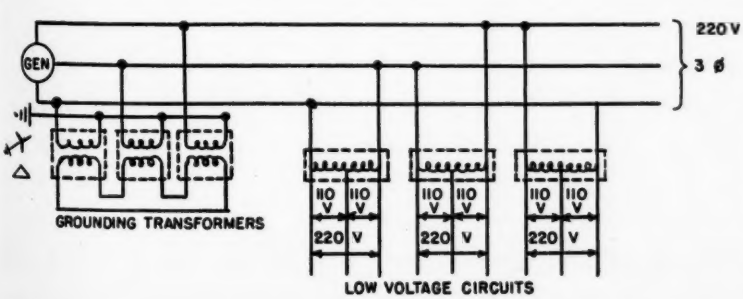
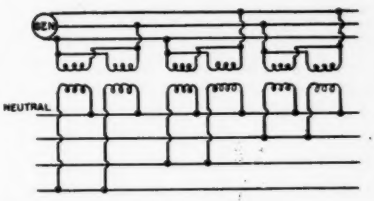


Diagram by von Dannenberg showing revision of original Fig. 4 of E.M.D. which will give satisfactory results

Parsons Recommends 4-Wire System

MY SOLUTION to your problem is shown in this diagram. Your hookup in Fig. 4 would do O.K. but a better solution is this connection, which is 4-wire, star, 110 v from any wire to ground. You



Dagram by Parsons showing how he would convert E.M.D.'s Fig. 4 into a 4-wire system to get the required balance

should load all transformers equally. This has all of the advantages of your 110-220-v single phase hook-up and will load all phases equally.

Akron, Ohio — P. PARSONS

Answer No. 361

WILL IT PAY TO USE EXHAUST STEAM IN THIS HEATING PLANT?

Goldsmith Says It Will

W. E. C. offers a slightly confused picture of the operation of his plant. He wants to know if he would be ahead of the game if he ran his steam-driven generator and air compressor and used the exhaust steam in the heating system. He says he runs a motor-driven generator and compressor in the summer. This is the confusing part of the picture. It sounds as if he doesn't run either generator or compressor in the winter or else they run the steam-driven equipment and exhaust to the atmosphere. This, of course, doesn't make sense.

The ideal set up for a plant of this type would be to run the steam-driven equipment during the heating season and use the exhaust steam in the heating system. In this way the engines act as reducing valves, taking only a small part of the available energy from the steam. The exhaust steam is fed to the heating system and, if more steam is required, live steam fed through a reducing valve makes up the difference. The power furnished by the generator and air compressor is practically a gain of 100 per cent.

Of course, many factors enter into any operation of this type that W.E.C. does not mention. Whether additional wages must be charged up to the steam driven equipment, added maintenance, the contract with the electric company, which I presume furnishes power, as W.E.C. has a 300-hp motor and mentions only a 130-hp generator. These and many other figures must be known to determine the most economical equipment to run during the various seasons of the year.

Beverly, Mass. — R. B. GOLDSMITH

Trigonometrical Nomenclature

The following diagram shows the dimensions used in the calculation of angles, with the names as applied to the sides of the angles. The names always refer to the angle on one side of the center line and not to the total or included angle.

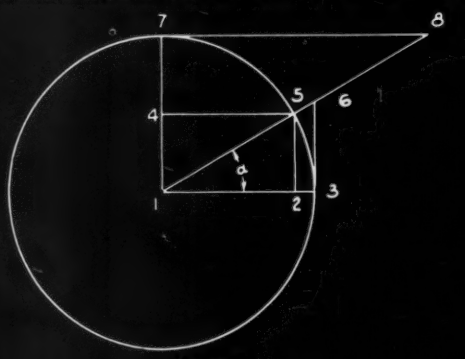


Figure No. 1

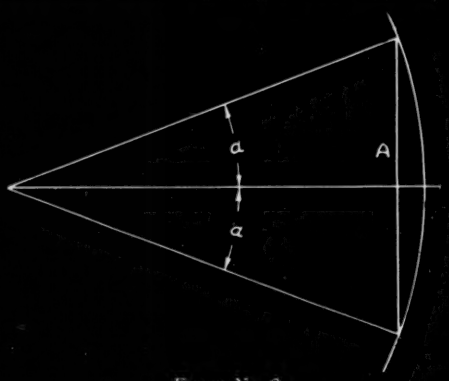
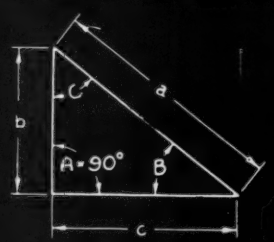


Figure No. 2

Lines 1-3 and 1-7 are called radius of the circle.

1-2 is called cosine of the angle.
4-5 is the same as cosine of the angle.
2-3 is called the versed sine of the angle.
4-7 is called the co-versed sine of the angle.
2-5 is called the sine of the angle.
3-6 is called the tangent of the angle.
7-8 is called the co-tangent.
1-6 is called the secant of the angle.
1-8 is called the co-secant of the angle.

The line A in Fig. 2, which is the shortest distance between two points on a circle, is called the "chord." Half the chord is the sine of the angle.



Trigonometrical Solution of Right-angled Triangles

As shown in the illustration, the sides of the right-angled triangle are designated a, b and c. The angles opposite each of these sides are designated A, B and C, respectively.

Angle A, opposite the hypotenuse a is the right angle, and is therefore always one of the known quantities.

Sides and Angles Known	Formulas for Sides and Angles to be Found		
Sides a and b	$c = \sqrt{a^2 - b^2}$	$\sin B = \frac{b}{a}$	$C = 90° - B$
Sides a and c	$b = \sqrt{a^2 - c^2}$	$\sin C = \frac{c}{a}$	$B = 90° - C$
Sides b and c	$a = \sqrt{b^2 + c^2}$	$\tan B = \frac{b}{c}$ or $\frac{b}{A}$	$C = 90° - B$
Side a; angle B Side a; angle C	$b = a \times \sin B$ $b = a \times \cos C$	$c = a \times \cos B$ $c = a \times \sin C$	$C = 90° - B$ $B = 90° - C$
Side b; angle B	$a = \frac{b}{\sin B}$	$c = b \times \cot B$	$C = 90° - B$
Side b; angle C	$a = \frac{b}{\cos C}$	$c = b \times \tan C$	$B = 90° - C$
Side c; angle B	$a = \frac{c}{\cos B}$	$b = c \times \tan B$	$C = 90° - B$
Side c; angle C	$a = \frac{c}{\sin C}$	$b = c \times \cot C$	$B = 90° - C$

Reprinted Courtesy D. O. James Manufacturing Co.

Balloon Baffle Assists Chemical Cleaning

Specially constructed pressure bags replace bulkheads used to dam water lines when chemically cleaning surface condensers

ONE OF the problems encountered in the application of chemical cleaning to the water side of large surface condensers is the plugging up of intake and overflow lines to prevent waste of chemicals. Although often in the installation, valves and flanges are provided with which the piping can be closed, many of these valves are found to be corroded or defective and cannot be closed. Or their location may be such that to use them would require a large quantity of solvent. Blank flanges are generally difficult to install due to the fact that too little space is provided in which to work. In many cases bulkheads have been placed in the lines but as a rule they are not too successful and are quite expensive to build.

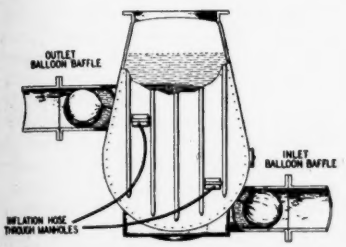
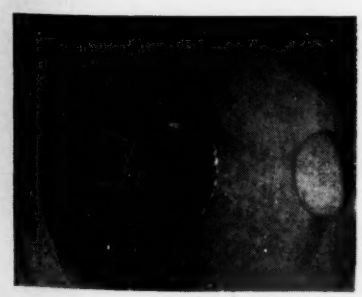


Fig. 1. Diagrammatic sketch showing application of balloon baffles in condenser circulating pipes during cleaning by solvent process

Fig. 2—above. Balloon seen from the condenser end in a 42 in. line. Fig. 3. End of balloon in 42-in. line away from condenser



Preparation work for the chemical cleaning of condensers has been considerably reduced by the use of a pressure bag developed by Dowell, Incorporated, specialists in this type of cleaning service. This bag is inserted in the line and then inflated with air. These specially designed ballons satisfactorily plug the lines so that they will hold against the pressure exerted by the scale removing solvent when the condenser is filled.

When the bags are applied in large condensers, it is necessary that they hold a great weight of solvent. For example, in the cleaning of a condenser serving a 30,000 kw turbine, 42-in. diameter bags were used to plug the lines. These bags were placed in the two lines and inflated. Then the total of 22,000 gal of solvent was pumped into the condenser which resulted in a 14 ft head. A differential pressure of 15 in. as shown on a manometer (see Fig. 4) was maintained between the air in the balloon and solvent it supports throughtout the treatment and none of the fluid was lost during the 4 hr required to remove the scale from the condenser.

The bags are made of Nylon fabric covered with rubber to withstand a skin tension of 800 to 900 lb, the design having been calculated after extensive research and experimentation, in which Dowell, Incorporated was assisted by rubber specialists. Tests were made to determine to what extent friction may be depended upon to hold the stopper in place at fluid heads of 10 ft or more. Although tests indicated a 42-in. stopper would have to be blocked at hydrostatic pressures above 5.75 psi or 13.28 ft head, several jobs have been successfully done without blocking. During one test, leakage around the stopper amounted to about 1 gal in 15 min.

Up to the present time, the largest condenser treated has been a Worthington two-pass surface condenser serving a 60,000 kw turbine. The cooling water in this case enters the condenser through a 36 in. ID and a 48 in. ID line. No difficulty was encountered with the bags during the treatment.

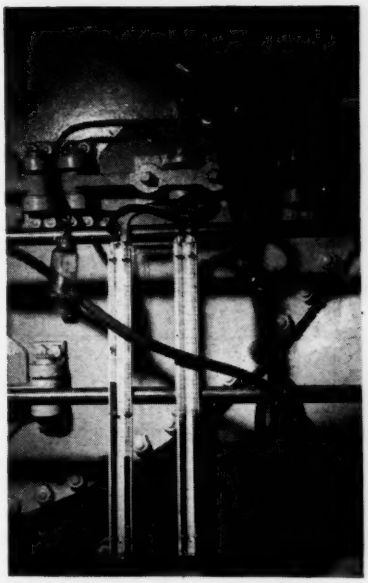
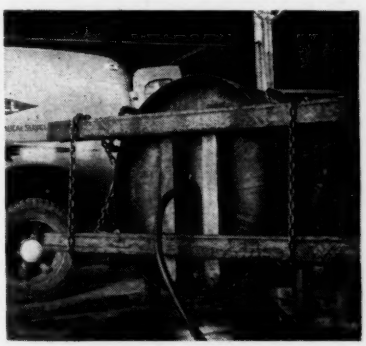


Fig. 4. Apparatus used to inflate balloon baffles and manometers to indicate pressures applied

Experience with the application of these balloon stoppers indicates that they can be used successfully with the largest condensers now in service, for it is a comparatively simple job to insert the bags and to inflate them so that they will hold against any desired solvent pressure without leaking during the cleaning process.

Cleaning condensers with solvents is a growing practice. The work is done in from two to eight hours and calculations of increased condenser efficiency show that the cost of treatments is about 10 per cent of the saving yielded. When used with some designs of condensers it is feasible to maintain an 80 per cent load on the turbine during the cleaning. The use of pressure bags to isolate the condenser and confine the solvent is another step in making the process more attractive to power plant operators.

Fig. 5. View taken during test of balloon baffle in a 42 in. pipe



How to Estimate Turbine Performance with Uncontrolled Extraction

By EDWARD V. POLLARD

(*Continued from page 77*)

of the low pressure extraction flow, and, therefore, the uncontrolled shell pressure line, starting from this point, is always at the same shell pressure. Figure 9 illustrates such a curve.

Case III—How to Estimate Uncontrolled Extraction Performance at a Pressure Lower Than Automatic Extraction Pressure as in Fig. 10.

The performance of a turbine with uncontrolled extraction pressure below the automatic extraction pressure cannot be presented in the same manner as described in the previous section because, at any one point on the reference line, the shell pressure at the uncontrolled opening varies with varying automatic extraction flow.

The performance curve will be plotted, using condenser flow as the ordinate, with the automatic extraction data at the right and the uncontrolled extraction data at the left, as in Fig. 11. Condenser flow equals throttle flow minus extraction flow. Since the uncontrolled extraction point is between the condenser and the automatic extraction opening, at any point on the zero extraction and reference axis the shell pressure at the uncontrolled opening is always the same.

The manufacturer's method of calculating the output of the uncontrolled opening at constant shell pressure and constant extraction flow has been described in detail previously. In this case the data are plotted condenser flow versus output with lines of constant extraction flow. Note that the increase of output as calculated is at constant condenser flow, see Fig. 11. An inspection of the plotted data at constant load shows that the difference in condenser flow between the zero extraction and reference line and any line of constant extraction line is equal to the extraction flow multiplied by a quantity equal to one minus the extraction factor where the extraction factor is calculated at the shell pressure corresponding to the condenser flow when extracting.

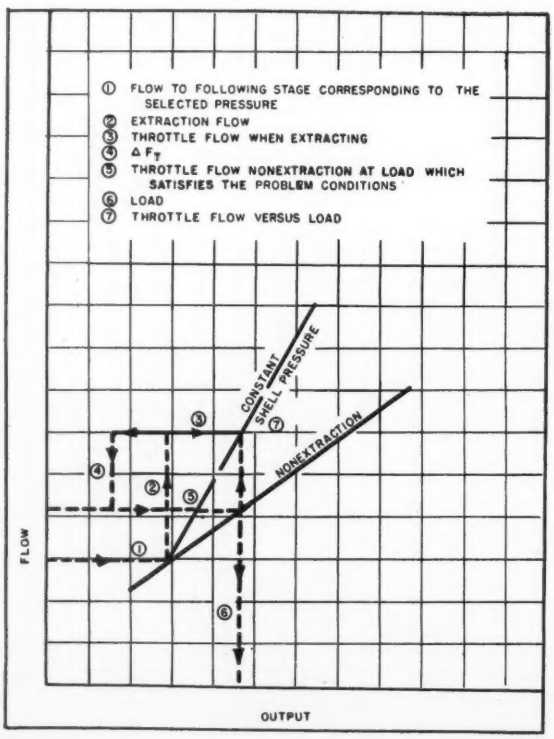

① FLOW TO FOLLOWING STAGE CORRESPONDING TO THE SELECTED PRESSURE
② EXTRACTION FLOW
③ THROTTLE FLOW WHEN EXTRACTING
④ ΔF_T
⑤ THROTTLE FLOW NONEXTRACTION AT LOAD WHICH SATISFIES THE PROBLEM CONDITIONS
⑥ LOAD
⑦ THROTTLE FLOW VERSUS LOAD
CONSTANT SHELL PRESSURE
NONEXTRACTION
FLOW
OUTPUT

Fig. 7. Method of constructing uncontrolled extraction performance curve of Fig. 4

How to Construct Estimated Performance Chart for Uncontrolled Extraction Below Automatic Extraction

The easiest way is to construct separate preliminary performance charts for each extraction opening by deriving the data in the manner described previously and then plotting it throttle flow versus output with lines of constant extraction flow. When deriving the data for uncontrolled extraction use the zero extraction flow versus output line from the automatic extraction calculations as the non-extraction flow versus output line.

Then cross-plot the automatic extraction data, at the right, plotting condenser flow versus output for lines of constant extraction. As mentioned previously, condenser flow equals throttle flow minus extraction flow. At the left select a temporary horizontal scale for output and cross-plot the uncontrolled extraction data, condenser flow versus output for lines of constant uncontrolled extraction. The temporary output scale at the left should be removed after the left-hand curve has been constructed.

This performance chart may now be used to determine the performance with simultaneous automatic and uncontrolled extraction. Enter at the right with a load, go vertically to a constant automatic extraction flow, move horizontally to the reference axis, go down vertically to a constant uncontrolled extraction flow, and move horizontally to the condenser flow. (See guide lines). The throttle flow is equal to the sum of the extraction flows plus the condenser flow.

It should be apparent from Cases II and III that automatic extraction with two uncontrolled openings, one above the automatic opening and one below the automatic opening, are not easily presented on the same performance chart.

Double Automatic Extraction Plus Uncontrolled Extraction

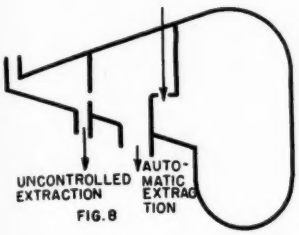
From the above discussion of the two methods of deriving and plotting the performance of automatic extraction turbines with uncontrolled extraction, it is apparent that the first method can be used with double automatic extraction provided the uncontrolled opening is above both automatic openings, and the second method can be used if the uncontrolled opening is below both automatic openings.

Uncontrolled extraction between two automatic extraction openings has never been seriously considered; hence, no discussion is presented regarding a performance chart for such an arrangement.

Limits of Performance Curves

In addition to the limits of the performance chart discussed in detail in Mr. Newman's articles, noted above, it

Fig. 8. Diagrammatic arrangement of turbine of Case II with uncontrolled extraction in addition to automatic extraction and at higher pressure



is now also necessary to consider the shell pressure at the uncontrolled opening when operating under extraction conditions. For Case II, the method was given for locating the lines of constant shell pressure at the uncontrolled opening; whereas for Case III, each condenser flow corresponds to a certain shell pressure at this opening.

It is not practical to show all limits on these performances curves; therefore, it is always desirable to check the actual section flow against the maximum and minimum section flows each time that data are taken from a performance curve.

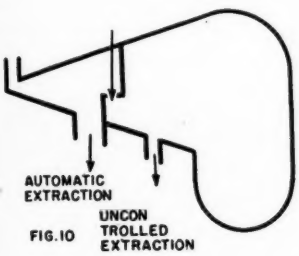


Fig. 10. Diagrammatic arrangement of turbine of Case III, with uncontrolled extraction in addition to automatic extraction but at lower pressure

Estimated performance curves for uncontrolled extraction with automatic extraction are not difficult to develop when the performance at each opening is considered separately before attempting to construct the combined curve; the uncontrolled performance chart is built up on an estimated shell pressure curve and extraction factors derived by using it, and performance curves for the automatic extraction openings can be developed from published data.

A final generalization to keep in mind when constructing multiple extraction performance charts: Starting with a flow versus output chart and either ascending or descending in the extraction pressure range, but not both, extraction performance charts may be pyramided on each other provided variations in extraction flow in succeeding charts do not change either the extraction pressure or extraction factor in previous charts.

Each uncontrolled extraction application is a specialized problem. In most cases, however, it will not be found feasible to extract more than about 15 per cent of the section flow.

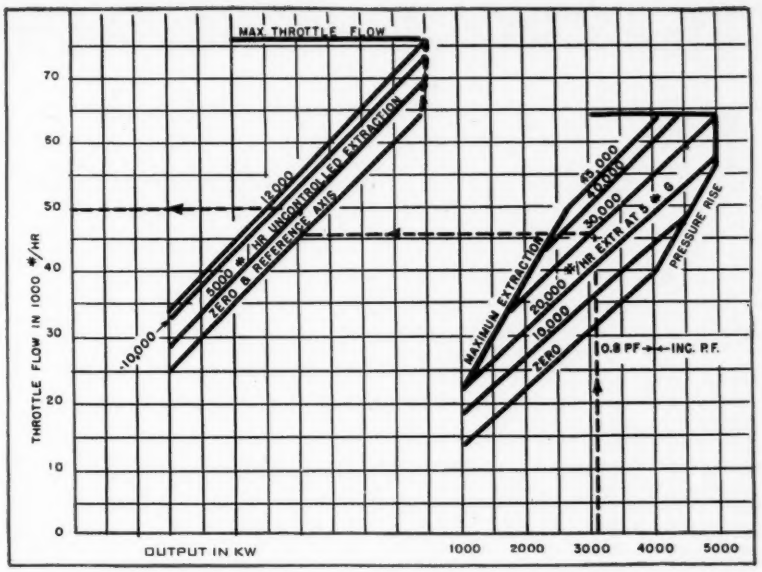


Fig. 9. Performance chart for Case II, turbine of Fig. 8, with uncontrolled extraction in addition to automatic extraction and at higher pressure

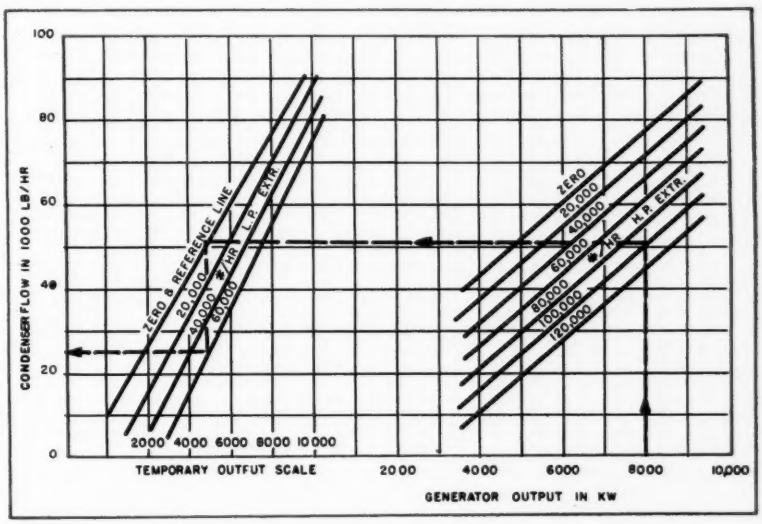


Fig. 11. Performance chart for Case III, turbine of Fig. 10, with uncontrolled extraction in addition to automatic extraction but at lower pressure

Uncontrolled extraction or admission turbines have limited flexibility to meet changing conditions. Their successful operation is dependent on close knowledge of their expected conditions of operation. If the conditions of load, pressure and flow are known within close limits; if these conditions are not likely to change in the future; and if the conditions do not vary much during operation then this type of turbine offers attractive economies in some cases. If all of these conditions are not met, it is generally safer to apply automatic extraction turbines. Uncontrolled extraction needs very careful study before going ahead with each application.

KEEP WATCH for steam and hot water leaks. Leaks may develop any place and at any time. A ⅛-in. steam leak in a 100-psi line loses over 50,000 lb of steam a month. Make sure that all valves close tightly.

PRACTICE PREVENTIVE maintenance. Keep boiler baffles and settings tight. Avoid overloading boilers. Make use of all available instruments. Use soot blowers regularly.

The Gas Turbine Power Plant - III

By JOHN I. YELLOTT

Director of Research, Locomotive Development Committee, Bituminous Coal Research, Inc.

ESSENTIAL COMPONENTS of the gas turbine plant are only three in number—compressor, turbine, and air heater. Fuel and lubricating oil must be supplied by appropriate auxiliaries, and governing must be accomplished in accordance with the plant requirements. If the economics of the situation justify the necessary investment, the efficiency can be greatly increased by transferring some of the waste heat in the turbine exhaust to the compressed air in a regenerator. Smaller but significant gains also result from the addition of the intercoolers and reheaters. Figure 1, reprinted from The Gas Turbine, by F. K. Fischer and C. A. Meyer, POWER PLANT ENGINEERING, May, 1944, summarizes the situation well.

Requirements and characteristics of each component will now be discussed, beginning with the compressor.

Compressor Requirements

Soderberg and Smith, Fig. 2, show that the "air rate," or pounds of air required per hp hr in the simple cycle depend upon pressure ratio, turbine inlet temperature, and to a lesser extent upon the regenerator effectiveness. For a t_{ri} (temperature at the turbine inlet) of 1350 F, and 50 per cent regenerator effectiveness, the compressor should deliver about 47 lb of air per hr per hp of net shaft output against a 5-to-1 compression ratio. At an inlet condition of 14.7 psi and 70 F, the specific volume of air is 13.35 cu ft per lb, so a compressor displacement of about 10 cfm must be provided for each useful shaft hp hr. It is immediately appreciated that the compressor capacity must be quite large, even for plants of moderate power.

The compressor should therefore be able to displace relatively large volumes at high efficiency against pressure ratios up to 4- or 5-to-1 if a regenerator is employed, and 6- or 8-to-1 if none of the exhaust heat is recovered. Piston-type compressors are not suitable for such large displacements, and so reliance must be placed upon rotating units.

Types of Compressors Suitable

The axial-flow compressor uses a relatively large number of sets of stationary

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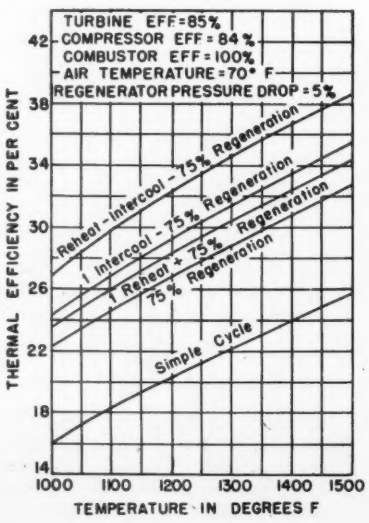
Part I, January issue explained the fundamentals of the gas turbine power plant, began at once to show performance calculations of a complete plant, to guide engineers in evaluating such a plant for various industrial conditions; reviewed components available; compared 5000-hp steam and gass turbine plants. Part II, February issue showed the actual calculations, simply made with the aid of diagrams and Gas Charts, for quantities of air and fuel, cycle efficiency, effects of adding regenerator, influence of regenerator effectiveness, etc. Subsequent articles will discuss detailed turbine calculations, straight line relations, operation, economics of plant.



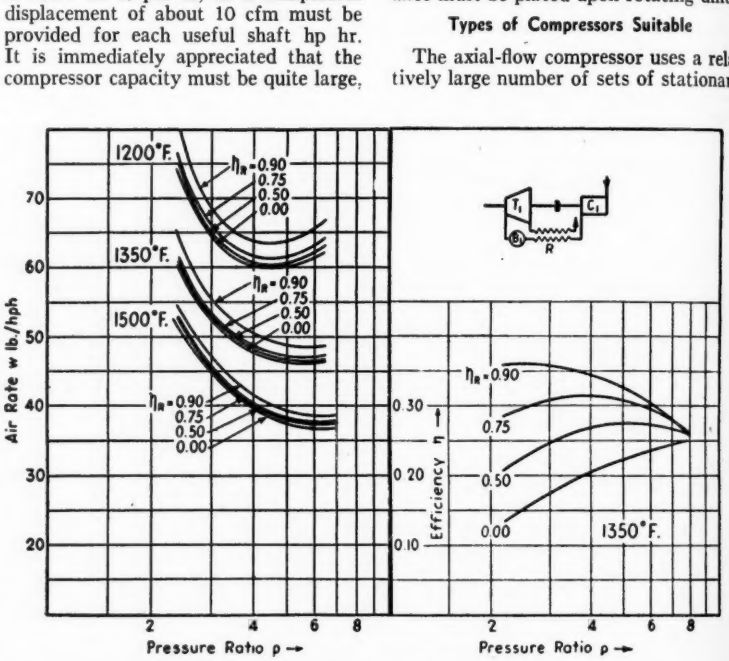
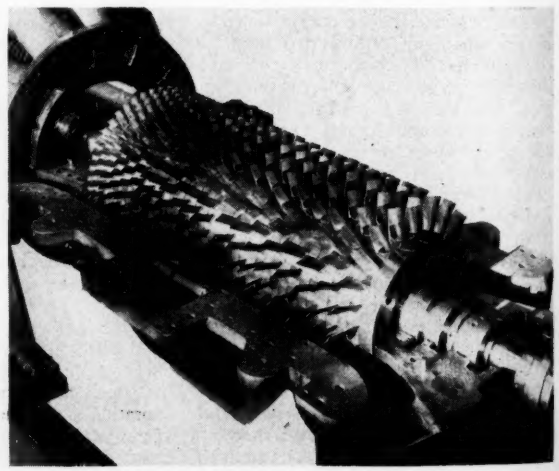


Fig. 1—left. Thermal efficiency for various modifications of the open gas turbine cycle (from The Gas Turbine, by Fischer and Meyer, *Power Plant Engineering*, May 1944)

Fig. 2—above. Air rate and cycle efficiency for the simple regenerative cycle (from The Gas Turbine, by Soderberg and Smith, *Power Plant Engineering*, April 1944)

Fig. 3—right. Twenty-stage axial compressor used in the Westinghouse 2000-hp gas turbine power plant



This continues the first textbook showing you how to calculate the plant as a whole . . . You can figure how a gas turbine plant might be built to fit your conditions . . . How to calculate and co-ordinate essential components of gas turbine power plant . . . Requirements and characteristics of compressors, air heaters, combustors . . . How characteristics of axial, centrifugal and positive displacement compressors work into design of plant . . . Details of characteristics and performance of each type . . . How to design air heaters and regenerators . . . How to calculate dollar value of regenerator . . . A new combination of regenerative and combustive air heaters . . . How combustors are designed . . . Pressure combustion . . . Ignition of fuel . . . Velocities of air in ducts . . . Combustor efficiency and operation . . . Insulation and metals for combustors . . . Turbine calculations in Part IV

and moving blades, generally similar to those in a steam turbine, to speed up the air and then to convert the velocity back into pressure. The centrifugal compressor imparts a high velocity to the air by whirling it with a vaned impeller, and using a diffuser to convert the resulting velocity into pressure. Only one type of positive displacement compressor, the Lysholm, made by Elliott Co., has thus far made its appearance in an operating gas turbine plant.

Summarizing the advantages and disadvantages of each, the axial is high in both efficiency and capacity, but relatively heavy and expensive. The centrifugal is simple, compact and relatively cheap, but its maximum efficiency and attainable pressure ratio are lower than those of the axial. The positive displacement type, as exemplified by the Lysholm, gives a fixed volume of air independently of the back pressure imposed upon it. Its capacity is a linear function of its rotative speed, while the operating pressure is not dependent upon the air quantity. Its pressure ratio is limited, however, as is its capacity.

Axial compressors have been used in most of the power units built up to the present time; centrifugal compressors characterize the highly successful aircraft propulsion units originated by Whittle and constructed both in England and the United States. The Lysholm compressor was incorporated by Elliott Co. in their first marine unit. Thus, each type has found a particular field of usefulness.

The axial-flow compressor is a very old development, since the late Sir Charles Parsons worked for many years to perfect its design. The Brown-Boveri Co. of Switzerland deserves much of the credit for the development of successful multi-stage units, however.

The axial-flow compressor is relatively unfamiliar to engineers who have been accustomed primarily to centrifugal or piston-type compressors; hence an explanation of its elements and characteristics is in order. The general appearance of an axial-flow compressor is shown in Fig. 3, which shows the unit now being tested as a component of the Westinghouse 2000-hp gas turbine power plant.

How the Axial-Flow Compressor Works

The behavior of an axial compressor can be understood from the velocity diagram in Fig. 4, which represents an intermediate stage. The air enters with an absolute velocity V_1 from the rotor of the preceding stage. The stator blades turn the air, and the expanding passage causes the velocity to be reduced to V_2. A small pressure rise results from this diminution in velocity. The absolute velocity of the air leaving the stator is V_2, and it is inclined towards the direction of rotation of the moving elements. The tangential velocity of the rotor, V_b, is greater than the tangential component of V_2, however, and so the velocity of the air stream relative to the rotor is V_2', inclined away from the direction of rotation. The rotor blades are shaped to receive the air at its existing relative velocity, and then to turn and accelerate it. The relative leaving velocity, V_3, can be caused to be less

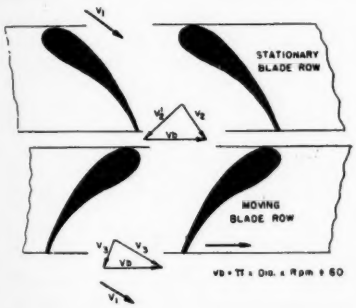


Fig. 4—left. Velocity diagrams for an intermediate stage in an axial-flow compressor

Fig. 6. Centrifugal compressor characteristics. Dash lines—total head. Solid lines—static head only (from Proceedings of The Institution of Mechanical Engineers, London, Vol. 153, 1945)

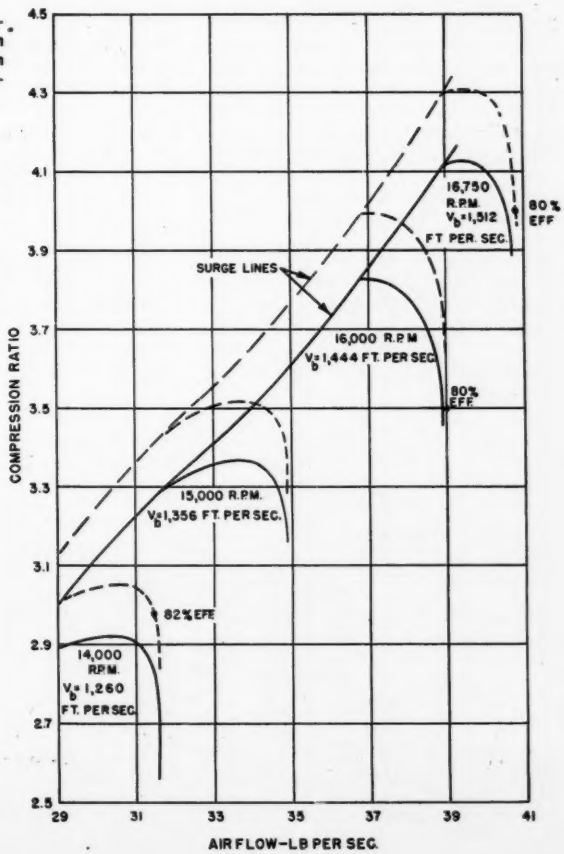
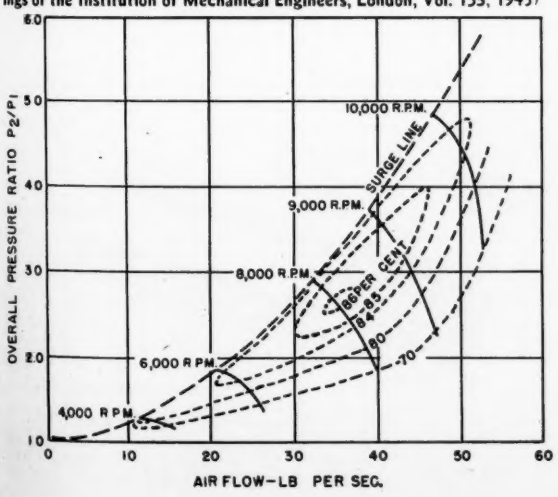


Fig. 5—below. Axial-flow compressor characteristics (from Proceedings of the Institution of Mechanical Engineers, London, Vol. 153, 1945)



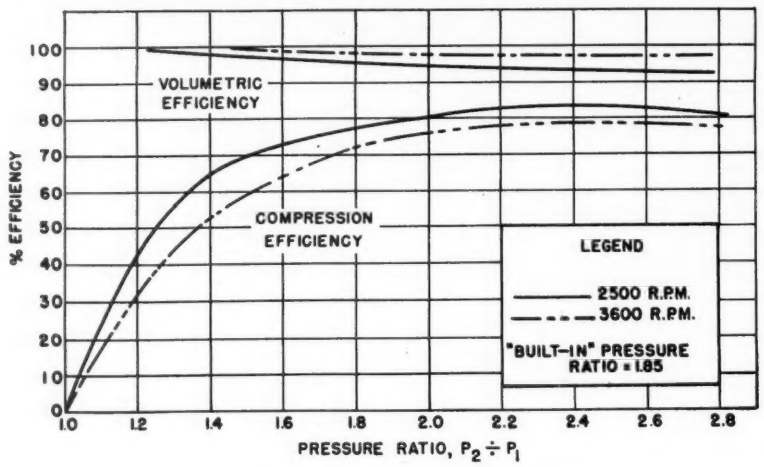


Fig. 7. Elliott-Lysholm compressor characteristics

than the entering velocity by increasing the blade path area at the discharge side, hence a rise in pressure again takes place. The absolute velocity, V_3, of the air increases, however, because the tangential velocity of the blade must be added to the relative velocity of the air. Thus, the moving air is restored in speed and direction if necessary to the condition shown by the vector V_1, representing the relative velocity entering the next stationary blade row.

The detailed designing of compressors is a highly specialized art.

Matters of blade spacing, allowable pressure rise per stage, and probable efficiency are treated particularly well in the series of paper published in Proceedings of The Institution of Mechanical Engineers (London), Vol. 153, 1945 (War Emergency Issue No. 12).

Characteristics of the Axial-Flow Compressor

The over-all performance of a given axial compressor can be most usefully expressed by the type of characteristic curves shown in Fig. 5. The principal curves show the pressure produced at any specified delivery volume for given rotative speeds. The dashed lines show the efficiency that obtains at each condition. The steepness of the pressure-volume curve is a fundamental factor in the designing of equipment to be operated in conjunction with an axial compressor. Increasing the dischare pressure produces only a small decrease in the delivery rate until a limiting pressure is reached, beyond which the compressor is no longer capable of consistent operation. A further increase in delivery pressure causes "pumping" to take place, with a tendency for the air to flow back through the compressor.

In the operation of a gas turbine plant with an axial-flow compressor, it must be realized that the flow of air into the unit is controlled by the rotative speed of the unit. The discharge pressure on the compressor outlet is established by the turbine, which acts as an orifice. Turbine and compressor must be matched, so that the turbine can drive the compressor at a suitable speed, and maintain the designed pressure over the operating range inlet temperatures. Figure 5 shows what will happen to the output of a particular compressor when its speed is varied. Fortunately, the open-cycle gas turbine plant can operate satisfactorily within the range of rotative speeds where the axial compressor maintains stable operation. Maximum speed variation which can be tolerated is from 100 per cent to about 60 per cent of designed speed. Below 60 per cent, the unit will probably not be stable, and speed governing should not be attempted.

The multi-stage axial compressor can be built for capacities up to 100,000 cfm, and for pressure ratios up to 6 or 8-to-1. Higher ratios have been reported for experimental aircraft-type units. Efficiencies of 85 to 86 per cent have been attained consistently in units where the blades remain clean. Deposits of dirt on the blades are harmful, since they tend to change the shape of the air passages and to alter the aerodynamics of the airfoil sections. In jet propulsion units operating in oily, dusty test locations, rapid deterioration of efficiency has been noted as deposits build up. Cleaning of the blades restores the original efficiency. Protection against coarse dust particles, pebbles, and other foreign objects is necessary, in order to prevent nicking or breaking of the blades.

Characteristics and Performance of the Centrifugal Compressor

The centrifugal compressor is quite similar in its appearance and performance characteristics to the conventional radial-bladed fan. Gas turbine compressors run at much higher speeds than power plant blowers, however, and consequently their pressure-delivery curves are much steeper, as Fig. 6 shows. The pressure rise per stage of a centrifugal compressor usually does not exceed 3-to-1, since even this limit causes the tip speed to approach the velocity of sound. Single-stage centrifugal compressors can attain efficiencies well above 80 per cent, but the efficiency falls off as the pressure ratio is increased. Addition of a second stage necessitates the use of scroll-shaped diffusers to lead the air back to the inlet of the second impeller. Maintaining a high over-all efficiency under these circumstances is difficult, and the maximum efficiency to be anticipated with such a combination is about 80 per cent to 82 per cent.

The capacity of the centrifugal compressor can be doubled by fitting both sides of the impeller with vanes. This arrangement has been used in many successful jet units, and it possesses the additional virtue of equalizing the axial thrusts on the two sides of the impeller.

Rotative speeds of centrifugal com-

Fig. 8. Parallel arrangement of combustive and regenerative air heaters for the coal-burning gas turbine

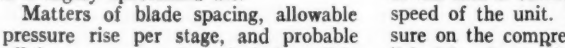
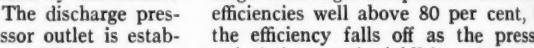


Fig. 9. Principle of operation of a gas turbine combustor



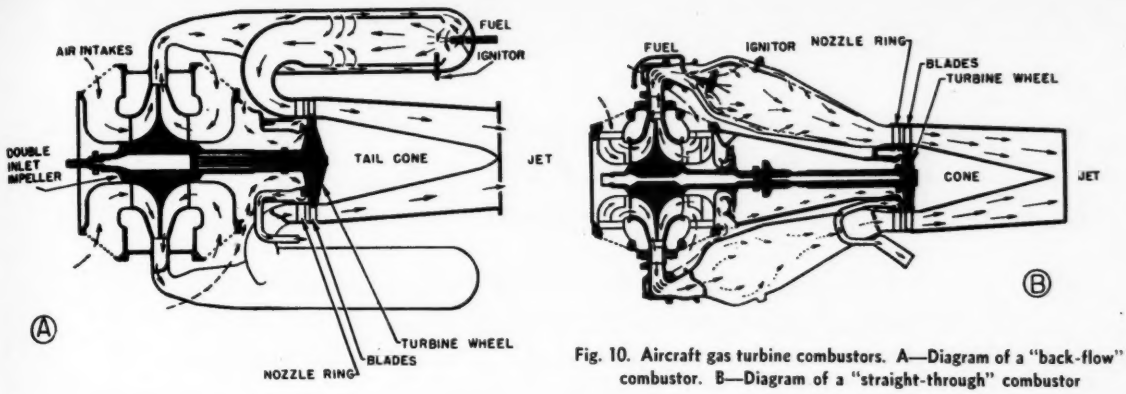


Fig. 10. Aircraft gas turbine combustors. A—Diagram of a "back-flow" combustor. B—Diagram of a "straight-through" combustor

pressors are normally higher than those of axial units. The small impellers of aircraft turbo-superchargers frequently operate at 20,000 rpm, necessitating very careful design. Balance must be perfect, in order to eliminate destructive vibrations. The centrifugal compressor, with only one or two stages, is expected to be much cheaper than the axial, and its length will be considerably less. Inter-stage leakage is minimized by using labyrinth seals. High pressure leakage will be less than 1 per cent of full-load flow.

Characteristics of Positive-Displacement Compressor

The positive-displacement compressor of the Lysholm type possesses characteristics, Fig. 7, which are quite different from those of the other two types. Displacement continues to be dependent upon rotative speed, but the delivery volume is virtually independent of the discharge pressure. Because of the unique design of the inter-acting moving lobes, the compression efficiency is quite high, but the pressure ratio is limited to about 3-to-1. It is accordingly best suited to the more complicated systems where several stages of compression, with intercoolers, are used to attain maximum thermal efficiency.

How Compressor Characteristics Compare

To summarize the compressor situation, the axial type can achieve any reasonable pressure ratio at good efficiency through the use of a sufficiently large number of stages. Its weight and length, in conventional construction, exceed those of a centrifugal compressor of similar capacity, and its first cost is also greater because of its large number of precisely machined blades. Its efficiency is lighter than either of the other two types, and its diameter is less than that of the centrifugal, which explains the current interest in axial-flow compressors for jet units. By using hollow discs and blades of aluminum, the axial type can be lightened to the point where it is competitive with the centrifugal.

Simplicity, ruggedness, and cheapness characterize the centrifugal compressor, which has to date found its major usefulness in simple jet—propulsion engines. Its wider range of stable operation also gives it an advantage in this field. For locomotive service, where reliability is of paramount importance, the centrifugal type is expected to be particularly useful. Elliott Co. is currently building such a unit for the 3,750-shaft-hp plant on order for the Locomotive Development Committee of Bituminous Coal Research, Inc.

Positive displacement compressors are not expected to be as widely used as either the axial or the centrifugal type. Necessity for the maintenance of small clearances is evident, in order to keep volumetric efficiency at a large level. The noise made by the twisted-lobe compressor, being very intense and low in frequency, is difficult to silence. The attainable rotative speed is low in comparison with the other two types. Wet compression has been successfully accomplished in an experimental Lysholm unit, with excellent results. The presence of a thin film of water on the rotating members appears to aid in maintaining a high volumetric efficiency.

How Design Air Heaters and Regenerators

The air issuing from the compressor in the gas turbine cycle must be heated so that, when it expands through the turbine, it can do more work than was done upon it. A temperature of at least 700 F must be attained if the unit is to run itself. At any higher temperature, excess power becomes available at the shaft or in the jet exhausting from the turbine. The compressor outlet temperature depends upon the inlet temperature, the pressure ratio, and the efficiency.

With a compression tratio of 5-to-1 and an efficiency, E_c, of 85 per cent, a temperature rise of about 370 F is to be expected, resulting in a total temperature of 440 F with 70-F inlet air.

The usual method of heating the air in an open-cycle gas turbine is by direct combustion of the fuel in the air stream. If the economics of the plant justify the additional first cost, a regenerator can be used to preheat the compressed air ahead of the combustor by transferring to it some of the heat in the turbine exhaust. The financial value of a regenerator can be estimated from a typical example. A locomotive-type gas turbine can be expected to de-

(Continued on page 140)

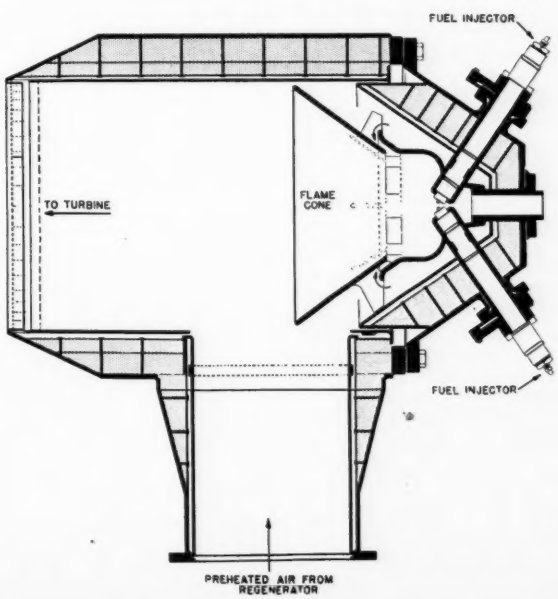


Fig. 11. Elliott elbow type combustor

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

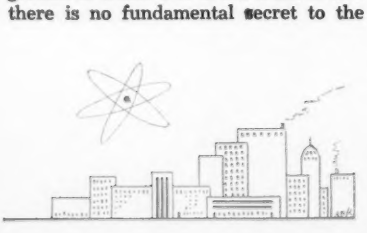
Who Gave Away What Secrets?

The secret of the atomic bomb . . . There was only one secret and it was kept exactly 21 days . . . Facts concerning secrets of manufacture of fissionable materials . . . The gaseous diffusion process . . . The electromagnetic process . . . Manufacture of plutonium by the self-sustaining chain reaction pile . . . The Smyth Report; What it is; who released it . . . Attitude of atomic scientists regarding secrecy

By **ANDREW W. KRAMER** Managing Editor, Power Plant Engineering

ONE OF THE most misunderstood if not tragic aspects of the development of the atomic bomb is that concerned with the so-called secret of the bomb. Despite all the efforts of the scientists who were closest to the development of the bomb to dispel the idea that there is a fundamental secret, there is still a tendency on the part of the public to believe that there is a vital secret which we as a nation can and should keep to ourselves. This is particularly true just now with all the agitation among certain factions in Congress to remove Mr. Lilienthal as Head of the Atomic Energy Commission. As reported by the newspapers, in high government circles, there are accusations and counter-accusations, each faction contending that the other has given away vital secrets underlying the development of atomic energy.

Just what is back of all this furor, why these matters have to be bandied before a gullible public is difficult to understand. Certainly there is no justification whatever for it on the ground of truth. For if the truth is told there is no fundamental secret to the atomic bomb that is not generally known to the scientists of all the nations of the world.



The one vital secret inherent in the development and use of the atomic bomb was disclosed to the world on the day we dropped the atomic bomb on the Japanese city of Hiroshima, and this was simply the fact that the atomic bomb *worked*. Until that time no scientist of any nation of the world knew definitely that the fission of Uranium-235 could be made to work in a practical atomic bomb. As reported by former Secretary of War, Henry L. Stimson, in his article in Harpers Magazine, in February of this year, while it was evident that the climax of our prolonged atomic efforts was at hand in the spring of 1945, it was impossible to state with certainty that we had succeeded until a bomb had actually exploded in a full scale experiment.

The idea involved in the bomb was known all over the world. Indeed, it was known from the instant that Hahn and Strassman in Germany made their announcement of the fission of uranium in 1938. It was their colleague, Dr. Leis Meitner, who showed the enormous amounts of energy that would be liberated by such a process and from that time on the principle of the atomic bomb was clear to almost everybody who understood the basic principle of nuclear fission. What was not known, however, was whether this principle could actually be made to work in an atomic bomb.

Curiously enough the nature of the atomic bomb is such that few nations were in a position to test the theory without spending a great deal of time, effort and money. In our own case, it took a matter of 4 years, millions of man-hours of effort, and the expenditure of some two billions of dollars. In retrospect it is clear now that no country in the world other than the United States and possibly Germany could have mustered such an effort during the war years. And so no group of scientists could test the theory of the atomic bomb. As is known, Germany was also at work on the atomic bomb during the war years. The original experimental achievement of atomic fission, as already mentioned, had occurred in Germany in 1938 and it was known that the Germans had continued their experiments. In 1941 and 1942 they were believed to have been ahead of us and it was vital that they should not be the first to bring atomic weapons into the field of battle.

Much of the success of our own effort was due to the fact that we knew this and that we were afraid that she might win the race if we did not go all out in our own effort to develop the atomic bomb.

It has been said that some of our own top flight scientists, some of whom were the active heads of certain phases of the work, were skeptical regarding

the possibility of producing a bomb. As late as March 15, 1945, as reported by Secretary Stimson, there was considerable apprehension on the part of certain high officials that the Manhattan Project might be a lemon. A number of men in the Army even lacked enthusiasm. There was, however, a small group of men, such as Dr. Firmi, Professor Urey, Dr. Arthur Compton and Dr. J. R. Oppenheimer who were firmly convinced that the bomb could be made to work and their enthusiasm did much to influence President Roosevelt to back the project with the full force of his dynamic personality. The whole idea of the bomb had appealed to Roosevelt's imagination from the beginning and his enthusiasm brought the Manhattan District into being. Secretary of War Stimson also pushed the project for all it was worth.

If there was difficulty in convincing certain Army and governmental agents in this country of the necessity of developing the atomic bomb, it appears that in Germany the scientists had even greater difficulty in convincing the top flight Nazis of embarking on a similar project. And it was this even greater reluctance on the part of the Nazis to accept the idea as compared with our own, that played into our hands. They were slower than we were and as a result we won the race. As a matter of fact, it now appears that Germany seems to have been far behind us.

We Kept Secret 21 Days

And so it was that on the morning of August 6, 1945 we dropped an atomic bomb on the city of Hiroshima in Japan and thus proved to the entire world that the atomic bomb worked. We had kept the secret for exactly **21 days.**

On July 16, as is well known now, we had exploded the first experimental atomic bomb in the desert at Alamagordo, New Mexico, and so *we* knew then that the bomb worked. On August 6, just 21 days later, we gave the secret to the world by dropping the bomb on Hiroshima. From that moment on, scientists all over the world knew with certainty that the nuclear fission chain reaction could be made to work in an explosive bomb.

Of course, one might contend that even though we disclosed the fact that the atomic bomb worked we still were the only nation in the world that actually knew how to make the bomb. This is true only in a practical sense. The fission of uranium by slow neutron capture, it may be recalled, had been demonstrated not only by Hahn and Strassman as early as 1938 but also by scientists in laboratories all over the world. Also it was clear to everyone that the fission process was confined to the rare isotope U-235 present in natural uranium only to the extent of 0.7 of one per cent. It was clearly evident, therefore, that the first step in the process of developing an atomic

JOHN SMITH AND HIS SECRET WEAPON

By Arthur Van Vlissingen

(From Monsanto Magazine published by Monsanto Chemical Co.)

Let us imagine that we lived in a little village a few hundred years ago when life was simple; when the bow-and-arrow was the deadliest weapon known. You and I were solid, respectable villagers, contented and confident of our future, the same can be said of our friend and neighbor, John Smith.

It is not particularly upsetting that a robber band one day tried to hold up John Smith's store. Bandits were no novelty then; there have always been crooks for honest men to cope with. It was gratifying to all of us that Smith secured a glorious victory over the bandits. Nevertheless, something that happened at that moment changed our entire outlook, jerked out from under us the sense of security upon which rested our way of life.

What turned our village upside down was the means that Smith employed to repel the attackers. You or I would have fought them off with knives, clubs or arrows. But John had a surprise in store for the robbers. He seized a secret weapon that he had invented and created behind closed shutters. Actually, though this was centuries ago, we are supposing that Smith had a 1947-model machine gun and ammunition. Two bursts from the machine gun killed all the bandits.

As soon as the first jubilation over the erasure of this criminal band had died down, you and I headed a delegation to visit Smith. We asked him to teach us to make guns so that we, too, might protect ourselves.

To our surprise, John refused. He explained, "I developed this dangerous weapon for defense against criminals. If you other people should get these terrible guns, some of you might be tempted to use them for robbery and murder. This would make life unsafe for all of us, myself included.

"Just relax, my friends. Everything will be all right. I will keep this gun locked up, and will see to it that our village does not become a horrible place where people go around shooting one another."

All of us know that John Smith meant every word he said, but we nevertheless became terribly uneasy. Suppose he should go insane, or, as other good men before him, have his character corroded by possessing tremendous power? If either of these should occur, he would probably kill or rob all of us. Even if he should remain for his entire lifetime the peaceful, honest John Smith known and loved by all, what still might happen when those wild sons of his should inherit the gun and its secrets?

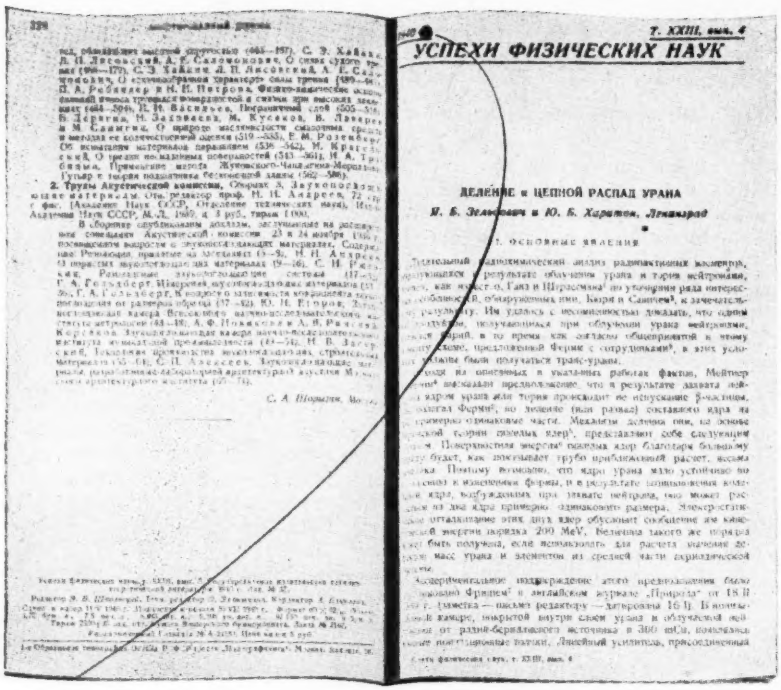
Now let us guess what you and I would do if we live in this village where bow-and-arrow has suddenly become powerless because one man has made himself a machine gun. Singly or together, we might easily convince ourselves that the only way to save our lives and our possessions would be to get guns even deadlier than John Smith's. Once possessed of these weapons we might decide that we must kill him before he could kill us.

In brief, the deadly weapon that Smith had made for his own protection and stubbornly refused to let anyone else have, would scare his neighbors into plotting his murder.

If Smith is as smart in other ways as he was in developing the gun and still does not want to harm his old friends, instead of sitting tight until we develop a better gun to kill him with, he will work out a plan to restore our peace of mind and save his own skin. Such a program would probably result in locking up his deadly weapon in a place from which it could be taken only by several of us in concert—call it joint control. We would have to work out an agreement that none of us would make more machine guns, and set up a method of making sure that this promise is kept in the future. Anyone caught cheating would suffer serious penalties.

In simplest terms, this parable of the villagers outlines the predicament in which the world stands today. United States, like John Smith, has the new weapon—the atomic bomb. The other nations fear and distrust the United States for having it—and will work like beavers to manufacture more and deadlier bombs than ours until some way is devised to make sure that United States cannot use the atomic bomb against them.

It will not be enough to convince the other nations that we do not intend to harm them. We must find ways to make it impossible for us to harm them, and at the same time we must make sure that they cannot use atomic explosives against us.



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УСПЕХИ ФИЗИЧЕСКИХ НАУК

ДЕЛЕНИЕ и ЦЕПНОЙ РАСПАД УРАНА

Ю. Б. Зельдович и Ю. Б. Харитон, Ленинград

1. ОСНОВНЫЕ ЯВЛЕНИЯ

The title of this 28-page Russian manuscript is "Fission and Chain Decomposition of Uranium." Published in the spring of 1940, its bibliography lists 85 papers on the same subject from British, Swedish, French, Italian, Danish, American and German periodicals

bomb was the isolation of a practical quantity of Uranium-235.

This was not easy. If U-235 had been a different chemical element, a chemical separation process would have been simple. But U-235 is an isotope of uranium and so a physical process of separation was necessary. Chemically U-235 and U-238 are exactly alike.

Uranium, which appears in natural mineral deposits, contains essentially two different isotopes—U-238 and U-235. A third isotope, U-234, does actually occur but only in extremely minute quantities and so it is usually neglected. Even U-235, the fissionable isotope, occurs only as 0.7 of one per cent of the U-238.

Now the U-235 and the U-238 vary only slightly in weight and so it is very difficult to separate them by a physical process. Yet that is the only way in which they can be separated since chemically these two forms of uranium look and act exactly the same.

It was the development of physical processes for the separation of U-235 from the natural uranium that took such a large part of the effort and expense in the development of the atomic bomb. Almost from the beginning four different methods were possible, but most of the effort was finally settled on two of these four, that is, the gaseous diffusion process and the electromagnetic process. The two others are the thermal diffusion process and the centrifuge method.

All of these methods are discussed in considerable detail in the Smyth report released by the Army shortly after Hiroshima so none of these methods can be regarded as being secret. Furthermore, the Smyth report also gave a very clear description of the character of the self-sustaining nuclear reaction pile in which uranium-238 is converted into the new element plutonium which is also a fissionable material and can be used in atomic bombs.

Both the gaseous diffusion process and the electromagnetic separation processes are simple to understand but enormously difficult and expensive to put into practical use. This fact is perhaps more important than that the methods could be kept secret, since it alone would prevent many nations from attempting to put the methods into effect.

As explained in the Smyth report, the thermal diffusion process is based on the fact that a compound of U-235 will pass through a porous wall or a porous barrier a little more readily than will the same compound of U-238. In the gaesous diffusion plant, a stream of gas containing a vaporized uranium compound is allowed to flow along a porous barrier. The concentration of the U-238 in the portion of the gas stream is about 1.003 times as great as it was prior to passing through the barrier. Similarly the concentration of U-235 in the portion which does not pass through the barrier is decreased slightly. Because the change in concentration resulting from a single such step is so small a tremendous number of barrier stages in series is required in an actual plant.

As is well known, to provide space for the large number of barrier stages required, a very large building was constructed at Oak Ridge, Tennessee to house the gaseous diffusion plant. It is the equivalent of a building one-half mile long by one-quarter mile wide and four stories high. The largest steam power plant ever constructed at one time supplies 238,000 kw of power and steam to this plant. The construction costs of the entire installation was about a half a billion dollars.

Similarly the electromagnetic process required a vast amount of material and a large plant. In the electromagnetic process a uranium compound is vaporized, passed through an electric arc where the atoms receive an electric charge and then through an electric field where the atoms are given a high velocity. These atoms pass into a magnetic field, the entire operation being carried out in a high vacuum. The two uranium isotopes, namely U-235 and U-238, follow a circular path, the lighter isotope U-235 following a path of shorter radius than the heavier one. Thus the paths are separated and containers placed at the proper points in each of the particular paths collect a different isotope.

The electromagnetic plant at Oak Ridge, Tennessee consists of many duplicate units located all in one plant for the convenience of control and operation, as well as for the sake of economy to permit the joint use of common facilities.

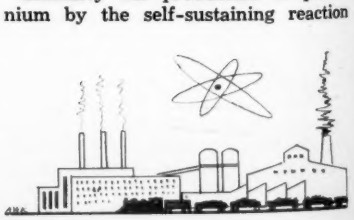
The Electromagnetic Plant

The plant consists of 175 buildings and cost approximately 317 million dollars. It consists of a number of production buildings, each building containing a number of single units set in giant electromagnets. Since copper was scarce during the war, it was necessary to use silver for winding the electromagnets. The Department of the Treasury loaned the Army over 14,000 tons or more than 400 million dollars worth of pure silver for this installation. At the height of production there were some 22,000 operating personnel. In addition, at the peak of the construction period there were 28,000 construction workers.

The electromagnetic process requires large amounts of electric power, complex electric equipment, complex mechanical equipment and a large amount of chemical equipment.

It will be clearly evident from this brief description that the construction of such huge plants could only be undertaken by a country of large size and with great natural resources.

Similarly the production of plutonium by the self-sustaining reaction



pile requires a great plant. Fundamentally the idea is simple and the first small pile built at the University of Chicago was a cube probably some 20 ft square. Such a pile, however, would produce only minute quantities of plutonium and so in the actual production of plutonium for the atomic bomb the plant at Hanford, Washington was built. The great plant at Hanford consists of three graphite uranium piles. In addition to these piles, however, it contains the necessary plutonium separation plants, pumping stations and water treatment plant. The piles are widely separated from each other and the plutonium separation plants are widely separated from the piles and also from each other. The separation plants contain canyons which are large channels built of concrete and are partially underground. Volatile radio-active elements are released in large amounts when the uranium slugs which have been in the piles are dissolved. These volatile radio-active materials must be trapped or if they are released, must be diluted greatly with air before they come in contact with centers of population.

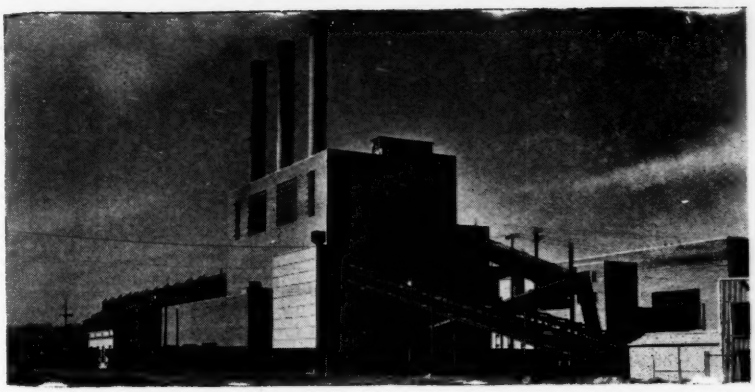
A large amount of cooling water must be used in order to dissipate the heat generated in the pile. For the production of 0.1 kilogram of plutonium a day it is estimated that from 50,000 to 150,000 kilowatts must be dissipated. This corresponds to about 170 million to 510 million Btu per hour. For purposes of comparison this is about the equivalent of burning 5 to 15 carloads of coal per day.

All of these methods and plants are described in considerable detail in the original Smith report. The reason for mentioning them here is to show that there are no fundamental secrets even in connection with the manufacture of the fissionable material. Whatever secrets there are, are of a purely engineering nature. They have to do with process technique and other engineers and scientists could, if given time and money, develop similar ones.

Who Issued the Smyth Report?

It is true that the issuance of the Smyth report immediately made available to scientists all over the world much descriptive data that might have been kept secret for a certain length of time. Whether in the end this would have helped matters cannot be said at the present time. Mr. Lilienthal told the Senate that the worst breach of atomic security was the Smyth report. It has been difficult to stop minor leaks because of the feeling that after the release of the Smyth report there could be no reason why this or that single fact, having no obvious relation to the bomb, should await the red tape of official declassification. As pointed out in an editorial in the February issue of the bulletin of the Atomic Scientists, Mr. Lilienthal's statement has been represented as a denunciation of scientists for not keeping atomic secrets. But Mr. Lilienthal made no such accusation. How could he? The Smyth report was prepared under the instructions of the Manhattan District and approved by General Groves. The suggestion attributed to Mr. Baruch that the Army was "lambasted" into its publication by the scientists is also ridiculous. The scientists were dumbfounded by the sudden publicity given to the industrial aspect of the atomic bomb project. Furthermore, as stated in the editorial in the bulletin of the Atomic Scientist, they were not interested in it. The firms which had participated in the immense enterprise may have had an understandable desire to publicize their achievements and the Manhattan District itself was anxious to show what it did with two billions of dollars. But the scientists were and are indifferent to the revelation of technological aspects of the production of fissional materials and the manufacture of bombs. They greeted the Smyth report as a portent of resumption of free publication of the results of scientific research; a practice which is considered by a vast majority of scientists as indispensable, not merely for their careers, but for the advancement of science as a whole, and thus for the well-being of the nation. This attitude has nothing to do with internationalism, still less with pro-Soviet leanings.

The example of fission shows how short may be the path from a discovery in pure science to a weapon in war. But to attempt to clamp secrecy on certain fields of science in the hope of monopolizing such developments would be ill conceived and dangerous. Nobody can presume to know what discovery in physics or bio-chemistry may bear the makings of a super-bomb or of a biological weapon of terrifying efficiency. If we lean backwards in supressing scientific publications because of their potential military implications, we will disrupt our own progress with dire effects for our peacetime advancement as well as for our military efficiency. To delay the making of atomic bombs by other countries without impeding our own progress, it would have made sense to keep the very existence of bombs secret by not using them in Japan. After Hiroshima it would have made sense not to reveal what materials were used in the bombs and what methods were successful in their fabrication. No scientist would have protested as a scientist, if complete secrecy had been preserved as to the plants at Oak Ridge and Hanford.



180,000 kw Steam Plant at Oak Ridge

Quoting from the bulletin of the Atomic Scientists: "Unfortunately, neither Congress nor public opinion has a clear understanding of the distinction between science and technology, between discoverers and inventors, between the revelation of facts and laws of nature, and the construction of plants and gadgets. That plutonium is formed by the absorption of neutrons in uranium, that it forms certain chemical compounds, and has certain physical properties including fissionability are facts of nature. They are certain to be discovered by scientists in other countries and their attempted suppression would have hampered American science causing confusion and unnecessary repetition. But revelations that plutonium can be and was fabricated in large plants, that it can be and was used for filling bombs, was in no way urgent and an invitation to engineers abroad to duplicate processes which they know can be successful. It is ironical that scientists are accused of a desire to reveal atomic secrets because they want to publish the properties of a new uranium compound, the nuclear characteristics of a new isotope or clinical observations of the effect of radiation, while the only important—and, from the viewpoint of scientific progress, unnecessary—revelations concerning the military and industrial aspects of atomic energy have come from the professed 'guardians of atomic security.' It was to them that Mr. Lilienthal's remarks should have been made—and we believe was—properly addressed."

50,000-kw Topping Turbine for Sherman Creek

In the February issue R. T. Roberts, Division Engineer of the Consolidated Edison Company of New York, described the million pound per hour boiler being installed at the Sherman Creek Station in New York. Now, in this article, H. Knecht describes the details of the turbine installation of this unit. This 50,000 kw topping unit will operate at a pressure of 1600 psi and will exhaust into the existing system at 200 psi

By H. KNECHT

Assistant Mechanical Plant Engineer, Consolidated Edison Co. of New York

AS EXPLAINED in R. T. Roberts article [1] in the Feb. issue to continue the plan laid out at the time of the first topping installation in 1943, the Consolidated Edison Co. has now under way the installation of a second high pressure boiler and turbo-generator.

Successful operating experience with the first unit has dictated duplication of the general layout.

The million pound per hour boiler feeds steam at 1600 psi, 950 F to the turbine through a single lead 17½ in. OD omitting the conventional and costly motor operated gate valve. The main steam piping has been so laid out that an anchor at the turbine causes vertical expansion in the riser to the superheater. The expansion is taken up in the long horizontal flexible superheater tubes that tie into the spring supported superheater header.

Feedwater to the boiler is controlled by a three element system in which the requirements of steam flow, water flow, and drum level are combined and satisfied by varying the speed of the turbine driven boiler feed pumps.

It is planned to use the same starting procedure on this unit which was successfully used on the first machine. The boiler and turbine are essentially brought up together, turbine and piping drains being held open until the boiler pressure reaches 400 psi. At that time the turbine exhaust valve is opened and from this point on, all of the steam passes thru the machine and into the station 200 psi system. Gland leak-off steam is carried to the sub-atmospheric direct contact heaters.

Absence of vibration difficulties with the present unit guided the selection again of a short foundation of concrete.

All of the piping has again been laid out in a simple single line system, eliminating costly by-passes, extra valves and cross connections. The choice of this type of system has been justified by our operating experience. Using practice carried on during the war, the turbine manufacturer is planning to ship the turbine and generator, each almost completely assembled. This will minimize the amount of field erection.

[1] Additional Topping at Sherman Creek. By R. T. Roberts, Page 108, Feb. 1947 issue.

Turbine Generator

The turbine-generator, manufactured by the General Electric Company is rated at 50,000 kw at 0.8 power factor, 13,800 v, 60 cycles, 3-phase, and operates at 3600 rpm. Design steam conditions are 1600 psi, 950 F at the throttle, 400 psi at the bleed point and 200 psi, 485 F at the exhaust.

As indicated in the cross section—Fig. 1, this turbine is a single flow double shell type machine having 14 impulse stages. The inner shells are not rigidly attached to the outer shells, being provided with supports and guides to permit radial expansion. The outer shells are supported by arms resting on the front and middle bearing standard. The middle standard is bolted and keyed to the foundation sole plate, and the unit expands forward toward the governor end. The turbine end standard carries the thrust bearing and is provided with a guide key and gibs so that it moves freely on the base underneath it. The thrust, being moved with it, maintains the relative clearances between rotor and stationary part throughout.

This turbine is equipped with 10 control valves arranged in two groups of five each and mounted on the upper and lower control valve casings which are integral with the top and bottom outer turbine shells. Of these 10 valves, six admit steam to different sections of the first stage nozzle, and four by-pass overload steam to the 4th stage shell. All valves are under control of the operator governing mechanism which is of the centrifugal type driven by the turbine shaft through a worm gear. A quick closing oil operated stop valve is pro-

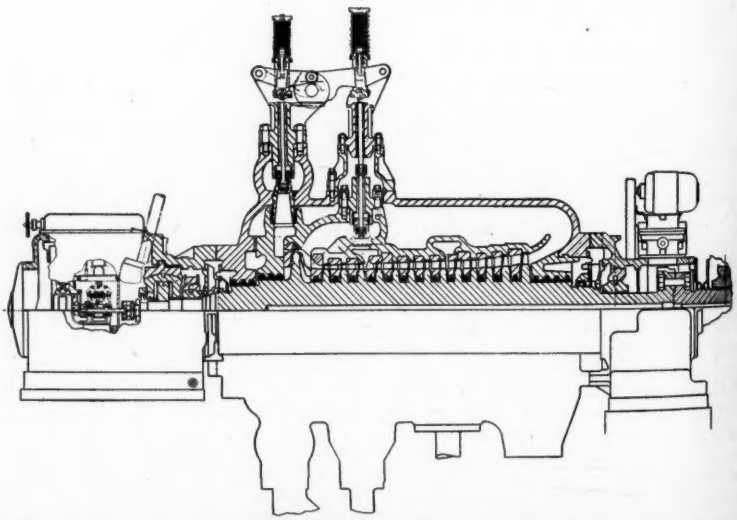


Fig. 1. Cross section of the 50,000 kw topping turbine. It is a single flow double shell machine having 14 impulse stages

vided for the steam inlet to the high pressure end. This stop valve is tripped closed by hand or by the emergency governor in the event of overspeed. Steam from this stop valve is admitted to the upper and lower control valve chests by two pipes designed with suitable flexibility.

Oiling System

Two main gear type motor driven oil pumps will be located in the main oil tank which will be installed in the basement. All the oil delivered by these pumps passes through oil coolers located inside of the oil tank. An auxiliary steam turbine-driven oil pump is also provided in the main oil tank, and supplies oil during starting and stopping of the turbo-generator. By means of a pressure regulator this pump automatically comes into operation when the oil system pressure drops below a predetermined point.

In addition a small motor-driven oil pump is provided to supply oil to the bearings when the unit is on the motor driven turning gear.

For supervisory control this machine is equipped with a vibration recorder, an expansion indicator, a shell and differential expansion recorder, an eccentricity recorder, a speed and cam shaft position recorder and a back pressure regulator.

The generator is hydrogen cooled and rated at 50,000 kw, 0.8 power factor, 62,500 kva, 3600 rpm, 13,800 v. With rated voltage and power factor at 15 lb hydrogen pressure the generator will have a maximum kva output of 115 per cent rated kva.

Hydrogen Cooling

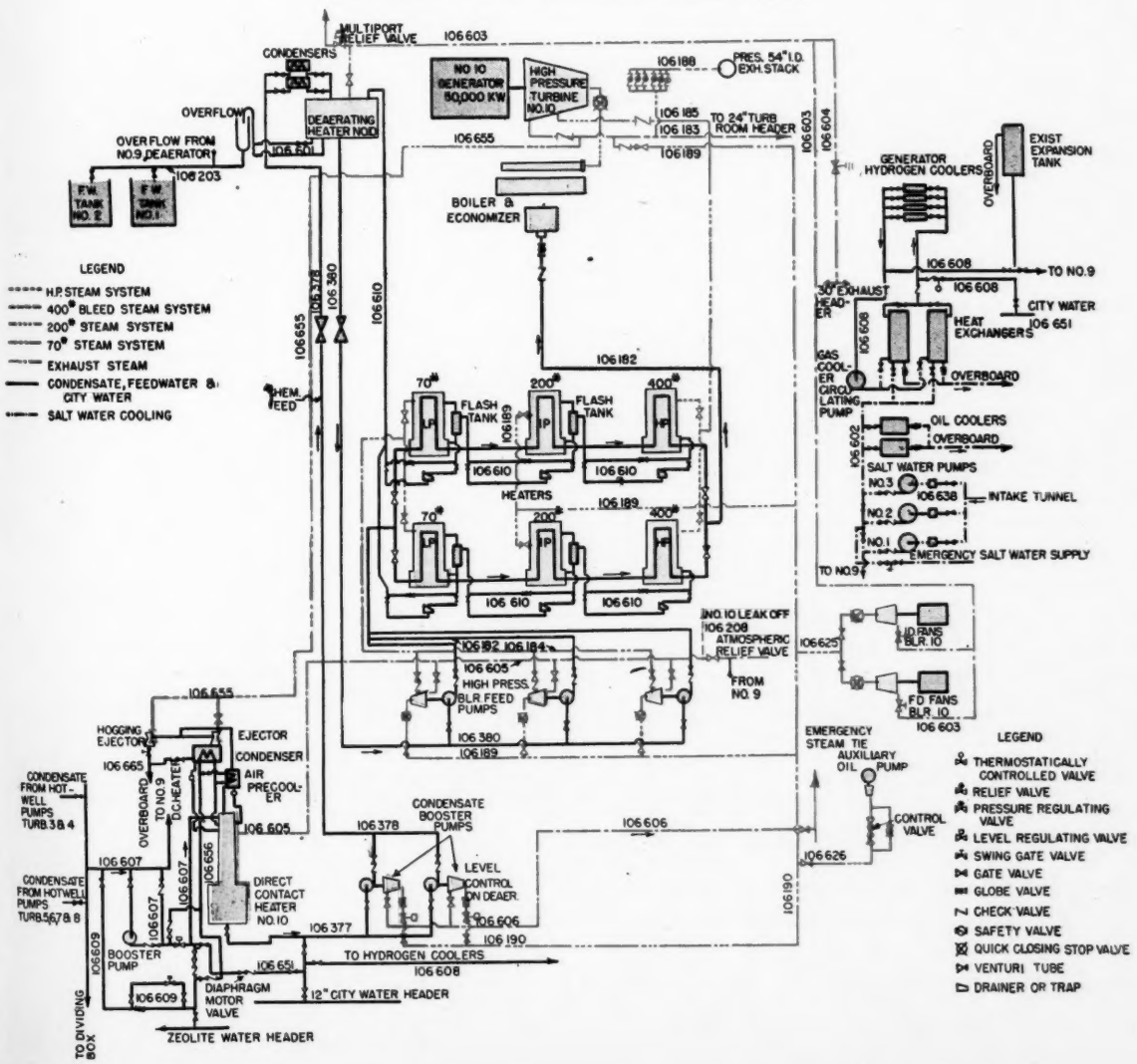
Four extended surface type hydrogen cooler sections are provided and located vertically, one at each corner of the generator stator outside the core portion. Water connections will be at the bottom and all water gaskets will be externally located to prevent leakage into the hydrogen space. The cooling is accomplished by fresh water which is recirculated and in turn cooled in a heat exchanger by using salt water. Proper equipment is supplied for vacuum treating the oil used in the shaft seals. These seals prevent leakage of hydrogen along the generator shaft.

Condensate System

Condensate from the low pressure turbine hotwell pumps is discharged into a common header feeding both the two remaining open heaters which supply the remaining LP boilers and the direct contact heaters related to the HP installations. The piping is arranged so that condensate goes first to the direct contact heaters and the excess to the open heaters for use in the LP boilers. In the condensate header to the direct contact heaters are installed vertical booster pumps, one for each heater, arranged to start up automatically when the direct contact heaters go atmospheric.

The direct contact heater installed

Fig. 2. Diagram of the steam, feedwater and auxiliary piping



PRINCIPAL EQUIPMENT — 50,000-kw TOPPING TURBINE GENERATOR — SHERMAN CREEK UNIT NO. 10
Consolidated Edison Co. of New York

Turbine
1 General Electric Co.; 50,000 kw @ 0.8 pf; 3600 rpm, single flow, double shell, 14 stage impulse type. Normal steam at the throttle is 1600 psi and 950 F exhausting at 200 psi and 485 F.

Generator
1 General Electric Co.; 50,000 kw, 0.8 pf, 62,500 kva, 3 phase 60 cycle, 13,800 v, 3600 rpm hydrogen-cooled unit, with air-cooled direct-driven exciter.

HEATERS

Direct Contact Heater
1 Elliott Co. vertical jet-type counterflow heater with twin steam jet air ejectors. Rated capacity designed to condense 20,000 lb per hr of steam with 642,000 lb per hr of feedwater to 3 psi absolute with effluent temperature of 140.5. F.

Deaerating Heater
1 Elliott Co. direct-contact tray type, with 2 vent condensers. Rated capacity 1,100,000 lb per hr, 18 psi absolute with 1000 cu ft water storage, dissolved oxygen content not to exceed 0.005 cc per liter (Schwartz-Gurney).

Closed Feedwater Heaters
2 sets of 3 Foster Wheeler Corp. vertical, 2-pass, U-tube Lockhead type heaters with integral hotwells. Each set consists of one 2090 sq ft of effective surface, 70-psig heater; one 1910 sq ft of effective surface, 195-psig heater and one 2650 sq ft of effective surface, 390-psig heater. The tubes 80-20 cupro-nickel.

PUMPS

Condensate Booster Pumps
2 De Laval Steam Turbine Co. single-stage, double-suction type 275 TDH, 20-ft suction lift; each pump driven by a Westinghouse C-225 turbine at 1875 rpm.

Boiler Feed Pumps
3 Byron Jackson Co. horizontal, 8-stage double-case volute type. Normal full load 460,000 lb per hr, 1800 psig, 222 F, 4150 rpm. Direct connected to a General Electric Co. 1685-hp variable-speed, condensing, automatic-extraction, mechanical-drive turbine with automatic turning device. Steam 200 psia, 485 F and 4 psia back pressure.

Salt Water Cooling Pumps
2 Warren Steam Pump Co., Inc. single-stage, double-suction type, each with a capacity of 2000 gpm against 100 ft total net head including 22 ft suction lift. Direct connected to a 75-hp Westinghouse 1800-rpm motor.

Hydrogen Cooling Water Pump
1 DeLaval Steam Turbine Co. single stage centrifugal pump; 400 gpm against a T.D.H. of 75 ft. Driven by a 15-hp, 1800-rpm General Electric motor.

Gland Cooling Pump
1 Ingersoll-Rand Co. single-stage centrifugal pump; 50 gpm against a T.D.H. of 125 ft. Driven by a 5-hp, 3450 rpm Westinghouse motor.

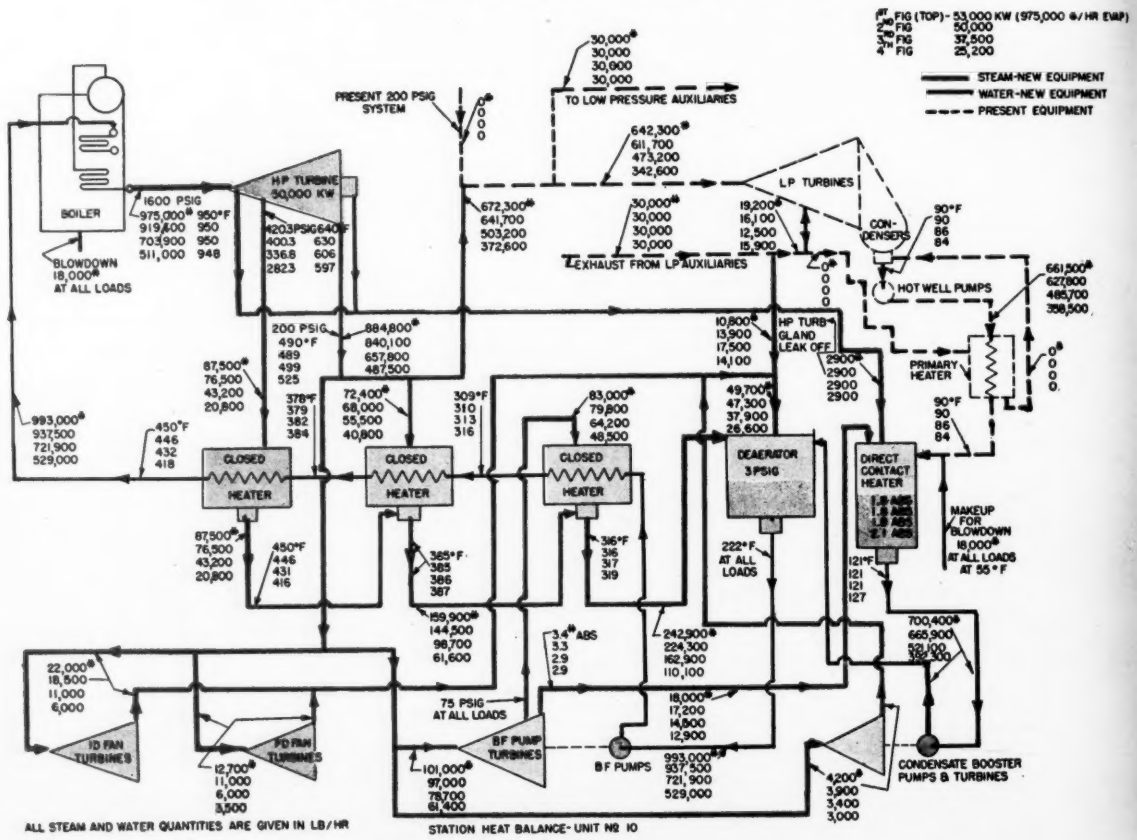
under this project is a vertical Elliott Co. jet type counter flow heater equipped with twin jet air ejectors, integral direct precooler, and surface type after condenser. This heater is designed to condense 20,000 lb per hr of steam with 642,000 lb per hr of feedwater to 3 psia with an effluent temperature of 140.5 F.

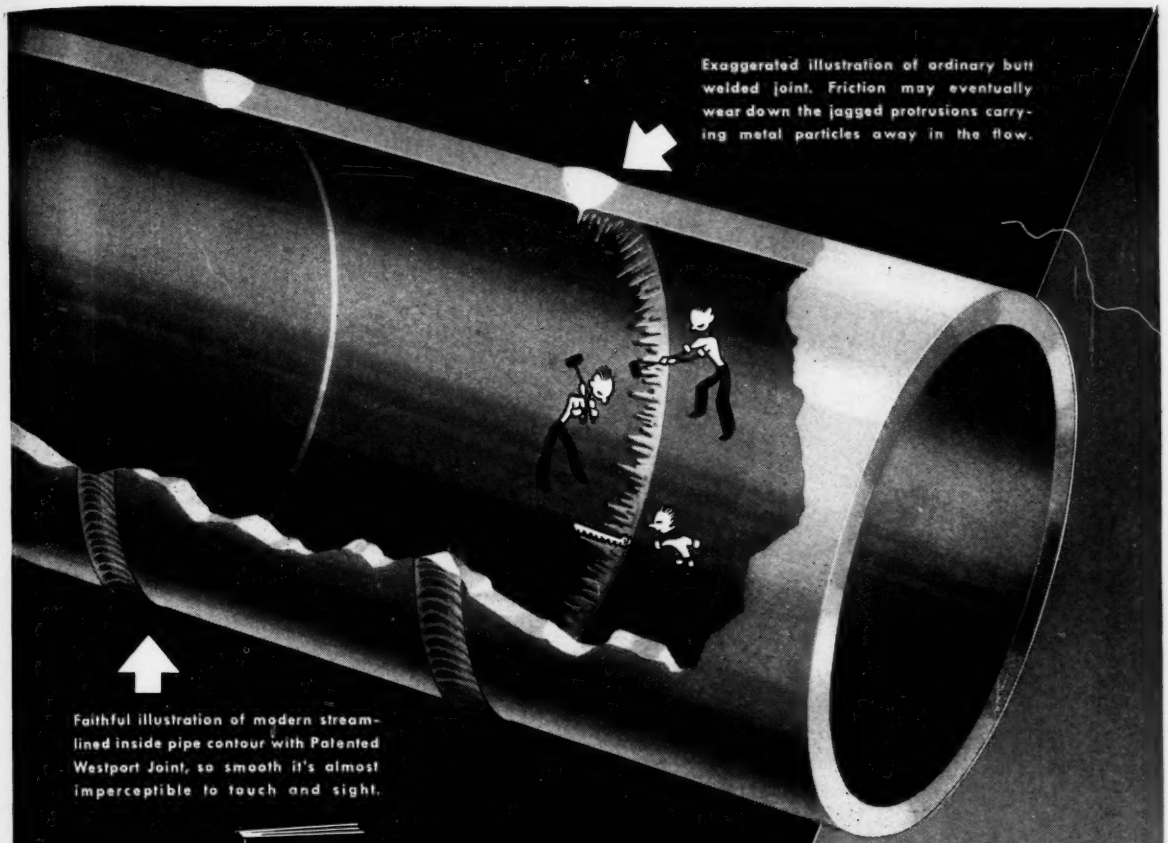
Two Westinghouse turbine driven De-Laval condensate booster pumps, one being a spare, take the water from this heater and pump it to the deaerating heater. The deaerator is an Elliott direct contact tray type equipped with two vent condensers so valved as to permit isolation of either one for overhauling, without taking the heater out of service. Heating steam at approximately 3 psig is supplied from the exhaust of the forced and induced draft fan turbines nearby and from the low pressure station auxiliaries. High pressure closed feedwater heater condenser returns are flashed into the shell above the water level.

Feedwater at approximately 222 F flows from the deaerator to the suction of the high pressure boiler feed pumps. The elevation of the deaerator is such as to maintain a positive suction head in excess of 40 psig at the pump centerline. As in the previous installation, there are three turbine-driven variable speed boiler feed pumps—two for full load operation and one spare. They are Byron Jackson eight-stage pumps incorporating the outer barrel and horizontally split inner case design. Normal full load capacity of each pump is 460,-

(Continued on page 148)

Fig. 3. Diagram showing the Station Heat Balance at various loads




Exaggerated illustration of ordinary butt welded joint. Friction may eventually wear down the jagged protrusions carrying metal particles away in the flow.
Faithful illustration of modern streamlined inside pipe contour with Patented Westport Joint, so smooth it's almost imperceptible to touch and sight.

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Some of the smoothest looking jobs of butt welding you've ever seen would give you the creeps, if you could see the inside of the pipe joint. We've exaggerated the icicle-like protrusions of weld metal which result when no backing rings are used, but we haven't exaggerated the smoothness of the Westport Joint. And remember, while pipe ends can be recessed to lessen the inside humps caused by backing rings, this reduces the wall of the pipe. . . . The Westport Method of Controlled, Two Stage Welding assures inside pipe contours smoother than the best outside weld you've ever seen and further, bondage and strength are maximum. . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today.

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Concrete Linings In Steel Stacks

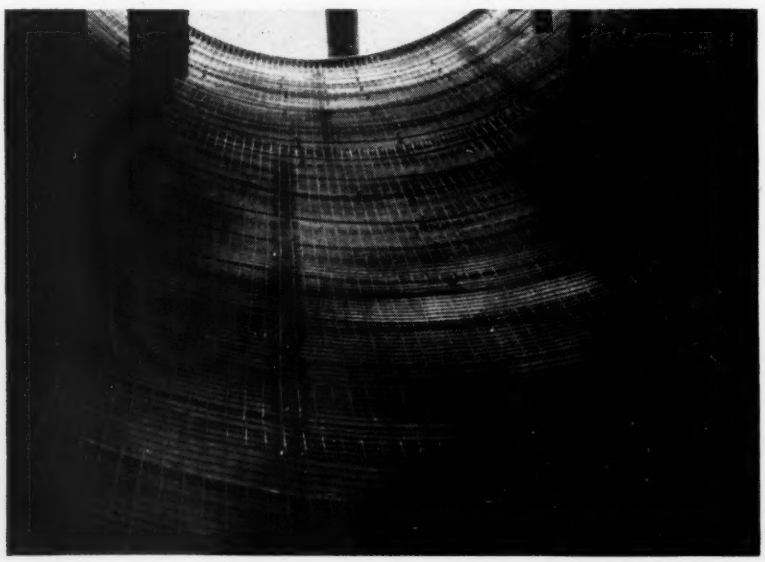
Characteristics of concrete linings . . . Linings are placed in steel stacks to protect the steel from corrosion and heat . . . The high efficiency of modern power plants has intensified the corrosion problem because of low stack temperatures. . . Concrete linings provide necessary protection when calcium-aluminate cement and special aggregates are used . . . Old stacks can be lined and continued in service . . . Simple methods of installing concrete linings insure long life for stacks, as shown by experience under severe conditions

By **G. T. HADDOCK**, Lumnite Division—Universal Atlas Cement Co.

LINING in a steel stack serves one or more of three principal purposes. (1) The lining protects the steel from corrosion. (2) It provides a refractory for high-temperature conditions. (3) It insulates the stack, raising the temperature of the gas and increasing efficiency. Secondary functions of the lining are to resist abrasion and to provide structural reinforcement.

Operating conditions indicate the characteristics needed in each particular lining. Greatest economy in construction, operation and maintenance results from selecting a type of lining which will meet the service requirements without additional expense for properties which are not needed. For example, it is not economical to install a refractory lining for higher temperatures when gas temperature will never be over 500 F.

Fig. 1. Reinforcing system for concrete lining in steel stack. Square nuts welded to shell, horizontal rods and wire fabric tied to nuts. Industrial power plant stack, 15-ft diameter, before placing a 2¾ in. lining of insulating concrete



Concrete linings allow selection of physical qualities because the properties of the concrete depend on the aggregate and the cement which are used. Also, such linings allow for installation of the exact thickness which is needed, as the thickness is not governed by the use of any standard-size units. If the engineer finds that a 3½-in. lining is needed for insulating effect, a 3½-in. lining can be installed as easily as one of any other thickness.

The type of cement used in making the concrete is determined by the need for resistance to corrosion and resistance to heat. Resistance to either or both of these destructive factors is required in the great majority of power-plant stacks. For that reason, calcium-aluminate cement is commonly specified.

Concrete made with calcium-aluminate cement is highly resistant to the sulphur acids contained in the flue-gas condensate which forms on chimney surfaces. The aggregate also must resist the acid attack. Siliceous sand meets this requirement, but can only be used at temperatures below 500 F. Fired-clay aggregates, such as crushed firebrick and Haydite, are resistant to the corrosive action and to heat.

High-Sulphur Fuels Aggravate Corrosion

The need for corrosion-resistant linings wherever sulphur compounds are present is generally recognized. The high operating efficiency of modern power plants results in the reduction of flue-gas temperatures and of the volume of excess air. As a consequence, stack temperatures tend to be below the dew-point, condensation is increased, and the corrosion problem is magnified. The condition is aggravated with high-sulphur fuels because the increased percentage of SO_3 not only increases the acidity of the condensate, but also raises the dew-point of the flue gas. Yeaw and Schnidman have shown that under these circumstances the condensate may be a fairly strong solution of sulphuric acid.[1]

If the flue gas penetrates the lining, condensate will form on the steel shell and will attack the steel. This effect is especially notable where there is an air-space between lining and shell or a space filled with porous insulating material. Pearson has pointed out that temperatures within the permeable lining and close to the shell will fall below the dew-point at certain elevations in the stack. The area affected will depend on the temperature and composition of the flue gas and on load fluctuation during a day's operation of the boilers. Inspection of thirty-three brick-lined stacks showed evidence of corrosion of the steel in all cases, deterioration being most marked in the top half of the stacks.[2]

The solution of the problem is to install a lining which is resistant to corrosion and which keeps the aggressive condensate away from the steel shell. This can be done with corrosion-resis-

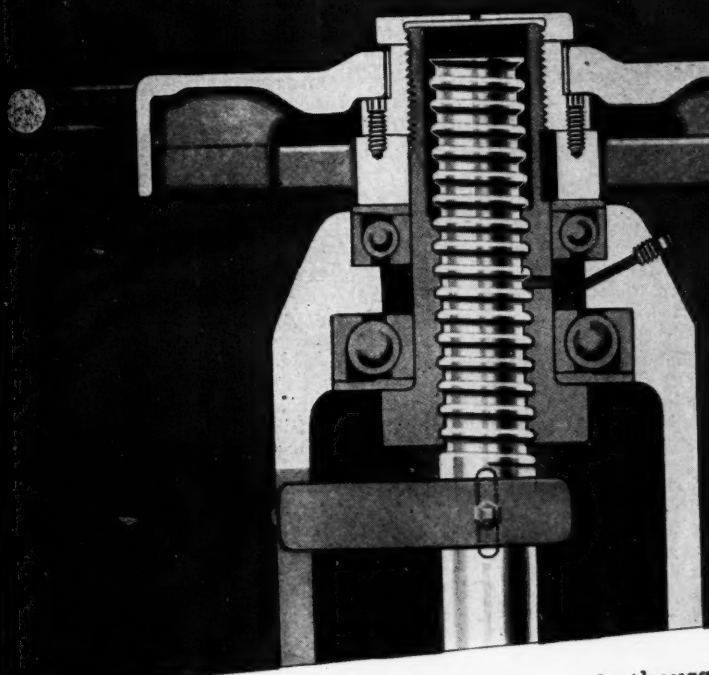
[1] Jesse S. Yeaw and Louis Schnidman. Dew Point of Flue Gases of Fuels Containing Sulphur. POWER PLANT ENGINEERING, Jan., Feb., March, 1943.

[2] Arthur S. Pearson. Deterioration and Maintenance of Power Plant Structures. POWER PLANT ENGINEERING, August, 1943.

ANOTHER EDWARD CONTRIBUTION TO BETTER VALVE PERFORMANCE

Edward EValthrust

YOKE BUSHINGS MAKE BIG VALVES EASY TO OPERATE even at high pressures and temperatures



Here are the advantages

The EValthrust yoke bushing is a heavy, high yield-point forging of aluminum-silicon-bronze with excellent wearing and non-galling characteristics. Hot forged as a single piece, it's distortion proof and can't get out of adjustment. Machining methods insure perfect alignment with the EValloy stainless steel stem.

Two angular contact ball bearings complete this compact, friction-free operating unit. The lower bearing takes the closing thrust; the upper bearing the opening thrust. Both, along with the strong external housing, take the radial load from the torque of the Impactor handwheel or motor control. Bearings are sealed from outside dirt, and a grease fitting permits lubrication. Threads of both stem and yoke bushing are an exclusive Edward form for dependable operation through a wide temperature range.

YOKE BUSHING troubles and mortality began in earnest, especially on big valves, when very high operating pressures and temperatures became common. Something had to be done—and here was the Edward answer.

Edward developed the ingeniously simple patented EValthrust yoke bushing to facilitate the closing of big valves against tremendous pressures. With its companion unit, the patented Edward Impactor handwheel, the EValthrust yoke bushing gives maximum closing torque in minimum space.

In thousands of important installations throughout the country, EValthrust equipped. Edward valves are busy, convincing proof that yoke bushing failures are wholly avoidable; that even the largest valves can be closed easily and tightly, though space is restricted and pressures and temperatures are extreme.

Edward Valves, Inc.

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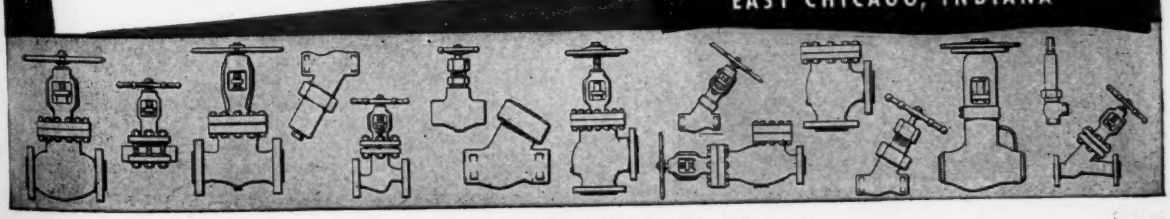


tant concrete placed in intimate contact with the steel. There is then no air-space or porous layer between the lining and the steel. The concrete lining may be cast in place, plastered against the shell, or shot on with a cement gun. In any case, the steel is not exposed and the corrosion-resistant lining provides the surface on which condensation occurs. Close contact between lining and steel is maintained during temperature changes, so there is no "breathing" to draw the acid through the lining and onto the steel.

Special Investigations

Present remarks on corrosion resistance apply to power-plant stacks or to those which discharge gases from sulphur-bearing fuels. Where corrosive agents other than combustion products of such fuels are involved, the resistance of the lining material must be determined by investigation, preferably by trial under actual operating conditions. In some smelters, chemical and processing plants, the stack gases may contain aggressive agents which will attack either the cement or the aggregate in a concrete lining. For these unusual conditions, it is practically impossible to predict the resistance of any lining material unless a trial section can be placed in the flue or chimney for observation.

The effect of heat on stacks is as important as that of corrosion, but it is more easily predictable. The designer of a stack generally knows the cycle of operating temperatures and he can allow for flash temperatures and secondary combustion. As a rule, it is not necessary to provide for temperatures above 2000 F in power-plant stacks. In fact, that temperature is considerably higher than need be anticipated in ordinary service. Consequently, a high-grade refractory lining is not needed unless called for by special service conditions.

Concrete for service above 500 F is known as heat-resistant concrete. It must retain strength under continued exposure to heat and must not disintegrate as a result of frequent cycles of heating and cooling. Concrete made with calcium-aluminate cement and a refractory aggregate has the necessary heat-resistant properties. This type of cement is used for making refractory concrete suitable for service at temperatures much higher than those found in power-plant stacks. But concrete with a service limit of 2000 F affords the greatest economy because of the availability of low-cost aggregates.

Aggregates commonly used for heat-resistant linings in stacks are Haydite and crushed firebrick. Haydite is an expanded, burned shale which is widely used as light-weight aggregate for structural concrete. Crushed firebrick, graded to suitable sizes, is the aggregate most frequently used with calcium-aluminate cement in making refractory concrete. So far as stack linings are concerned, the principal difference between these two aggregates is in the weight and insulating effect.

Trap-rock screenings can be used for aggregate where weight and insulation are not important. Concrete made with calcium-aluminate cement and trap-rock is good for temperatures up to 1800 F. It offers excellent resistance to corrosion and abrasion. Trap-rock has the advantage of being an expensive, natural aggregate, but in many parts of the country it is not obtainable.

Sand should not be used for aggregate when the concrete will be exposed to temperatures above 500 F. The volume-change of the silica particles when suddenly heated above that temperature may cause cracking and spalling. Limestone aggregates, commonly used for structural concrete, are not suitable for stack linings, because they are not resistant to the heat and corrosive action of the flue gases.

Insulation is often an important factor in selecting the type of stack lining. With the concrete lining, a fairly wide range of thermal conductivities is available through selection of the proper aggregate. Haydite concrete, made with calcium-aluminate cement, has a conductivity (K-factor) of approximately 3.0 Btu/hr/sq ft/inch/deg F at a mean temperature of 1000 F. With crushed-firebrick aggregate, the K-factor of the concrete is approximately 7.0. This compares with a K-factor of 8.0 for fireclay brick at the same temperature.

The significance of these conductivities as applied to stack linings is in determining the thickness of lining required to minimize the temperature of the steel shell and to maintain the temperature of the flue gas. The thermal resistance of a 3-in. thickness of Haydite concrete is equal to that of an 8-in. thickness of firebrick. As firebrick linings generally have an air-space or mortar between brick and shell, it can be conservatively estimated that a 2½-in. Haydite-concrete lining is at least equal in insulating value to a lining of 4½-in. firebrick plus air-space.

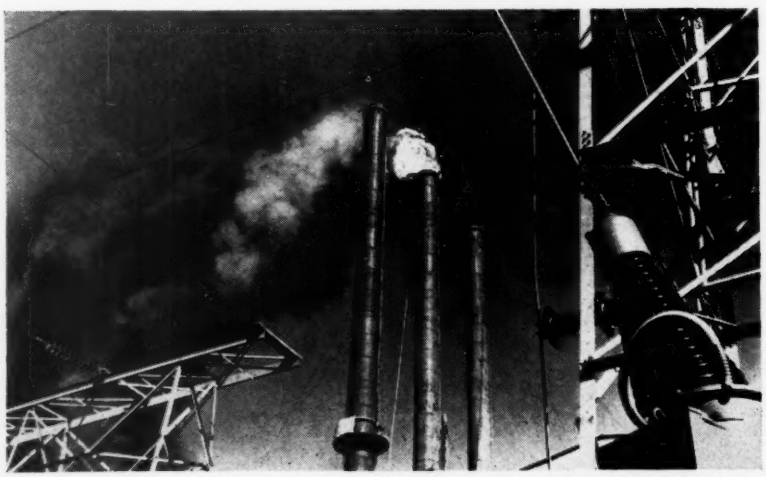
The relatively thin insulating-concrete lining allows greater effective area of stack for the same diameter of shell. In the example mentioned in the preceding paragraph, the diameter inside the concrete lining would be about 7 in. greater than the inside diameter of the brick lining. For a new stack designed with a concrete lining, the size of the steel shell can be proportionately reduced. In the case of an old, unlined stack in which a lining is placed, the insulating effect will tend to raise the gas temperature, thereby compensating for the reduction in capacity caused by the slight reduction in area.

Weight of the concrete is determined by the aggregate. In lining an old, unlined stack which is supported on structural members, it may be necessary to use light-weight aggregate to reduce the dead load, even though the extra insulation is not needed. Comparison of weights of several types of concrete lining is given in accompanying Table.

Abrasion resistance of a concrete lining does not ordinarily require special consideration in designing power-plant stacks. Pearson states in reference to power-plant flues that the abrasive effect of flue gas is small when not preceded by corrosion.[2] Therefore, a dense, corrosion-resistant lining can be expected to minimize abrasion. The concrete lining has no joints, so another starting-point for abrasive action is eliminated. Where the flue-gas carries an unusually large volume of abrasive particles at high velocity, it is advantageous to use a hard aggregate such as trap rock.

The value of the lining as structural reinforcement is incidental to its primary functions. But the concrete lining is effective in reinforcing the shell against ovaling and in dampening vibration. In repairing a badly corroded, unlined stack, the strengthening and stabilizing effect of a concrete lining is important. The lining may make it possible to salvage a stack which would otherwise have to be replaced.

Fig. 2. Three 200-ft stacks at power plant burning acid sludge from oil refineries. Insulating, corrosion-resistant concrete linings protect steel under unusually severe conditions



Installation of Concrete Linings

The lining is essentially a thin slab of concrete in close contact with the

Every Inch "LIVE STORAGE"

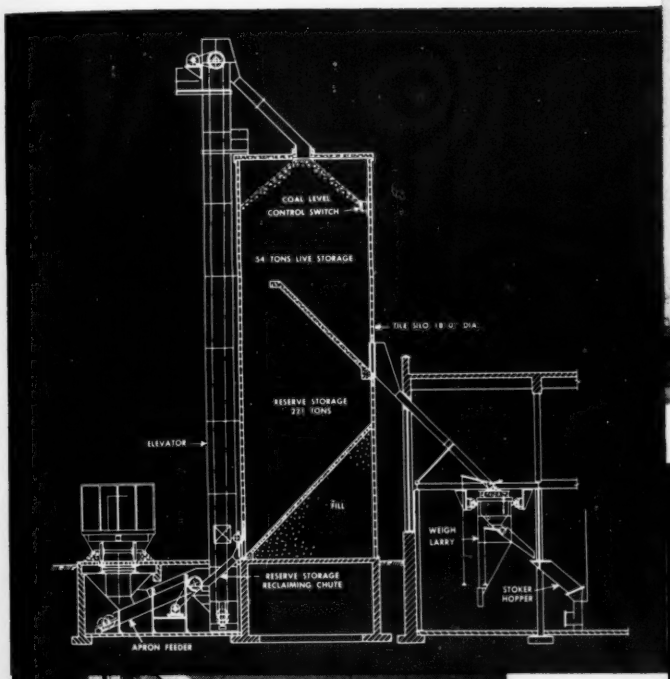
Every Inch G-W Design

With reclaiming chute and elevator linking reserve to live storage, the silo of the G-W coal-handling system shown here is, in effect, *every inch* live storage from the ground up.

Completely mechanical, this system handles bituminous stoker-size coal from hopper-bottom cars to stoker hoppers in boiler room, with minimum labor. It's in service at the Veterans Administration, Fort Custer, Mich. The whole design was conceived by G-W . . . all the mechanical equipment furnished by G-W.

The G-W *plan* of centralized responsibility saves time and money, speeds the whole project.

On coal-handling problems like this – or on those that vastly differ – the straightest line to efficient solution runs right through a Gifford-Wood office. For complete engineering service, contact the one nearest you.



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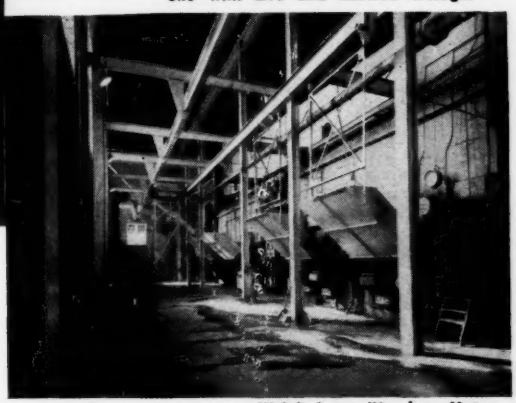

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Fig. 3. Shooting concrete lining in steel stack. Section of 200-ft stack, diameter about 8 ft

steel shell. The structure may be considered as a composite section of steel and reinforced concrete. It follows that the most important construction detail is to obtain an intimate union of concrete and steel. The gunite method has been found to be very effective in achieving this result. But a tight bond with the steel can also be obtained when the concrete is cast in place or plastered on the shell by hand. For a specific installation, the most economical system can be determined by considering size of stack, thickness of lining, availability of equipment and of competent labor.

As the majority of power-plant stack linings are from 2½ to 3½ in. thick, these comments on design and construction refer mainly to gunite and plastered linings. Cast-in-place concrete is more suitable for thicker sections where there is sufficient room to allow the concrete to be worked tightly against the shell.

Before installing reinforcing, the steel shell should be cleaned to remove rust, soot and dirt. In old stacks, it is desirable to sand-blast the steel. In new stacks, the inside surface of the steel should not be painted. If a preservative coating has been applied, the coating should be removed in order to insure a tight bond with the concrete.

Reinforcing usually consists of wire fabric attached to hangers which are spot-welded to the inside of the shell. Welded wire fabric with a 3 by 3-in. mesh is preferred. The diameter of the wire should be approximately ⅛ in. or No. 10 gage. (Such as A.S. & W. 33-1010). The fabric may be either plain or galvanized. Any similar system of reinforcing may be used, provided that it is sufficiently open to allow the concrete to fill the space between reinforcing and shell without arching or hanging. A simple method of placing reinforcing is to tie the wire fabric to short lengths of 1 by 1-in. angles which have been spot-welded to the shell. Special hangers have been designed for this purpose, but any arrangement that will hold the fabric in place and allow for easy installation is satisfactory.

Location of reinforcing in the concrete section is most important, especially for a high-temperature lining. With a 2½-in. lining, the fabric should be about one inch from the surface of the steel. Care must be taken to see that the fabric is not placed any closer to the inside face of the lining than is necessary. If it is too close to the hot face of the concrete, the steel may reach a temperature at which it will be oxidized or reduced in strength. For corrosion resistance, the steel should have a cover of at least 1 in. of concrete.

Expansion joints are not usually provided in concrete linings. Experience indicates that the actual expansion of the lining is practically the same as that of the shell. The reinforcing wire and the bond of lining to steel appear to take care of differential expansion. Cracking or breaking away of concrete because of temperature change has not been reported after inspecton of any concrete-lined stack.

For a stack lining, the concrete mix generally consists of one part of calcium-aluminate cement and three parts of aggregate, by volume. The sand or refractory aggregate must be well graded to give a workable mixture which will yield dense concrete. Aggregate should not contain particles larger than ⅜ in. For hand-plastered work, it may be necessary to add plastic fire clay to improve the workability of the mix. The fire clay should not exceed 10 lb to the bag of cement. Other plasticizers cannot be used with calcium-aluminate cement, as they affect the setting action and reduce the resistance to corrosion and heat. The lining should be applied in a single thickness, without laminations.

One of the advantages of using calcium-aluminate cement is the speed with which it hardens. The concrete gains high strength within 24 hr of placing. But the quality of the concrete depends on proper curing at the right time. During the curing period, the top of the stack should be covered in order to eliminate draft. The surface of the concrete should be kept moist by sprinkling.

Breechings and flues are lined in the same manner as stacks. The gunite or plastered linings are especially convenient for installation in curved and tapering flues, and for multiple flues leading into a header. As in stacks, linings resistant to heat and corrosion are generally needed in power-plant flues. Corrosion-resistant linings are particularly desirable in flues which pass from the boiler house into the cooler outside air.

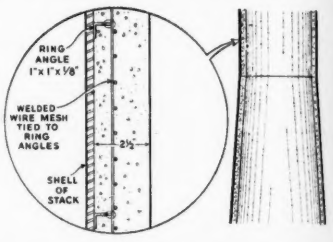

Fig. 4. Sketch of typical concrete lining in steel stack, showing simple reinforcing system

For average power-plant service, the most important requirements are that the lining withstand high temperature at the lower part of the stack and be resistant to corrosion in the upper portion. Both requirements can be met by installing from top to bottom a single thickness of concrete which will resist both heat and corrosion.

WEIGHTS OF CONCRETE LININGS

Aggregate	Maximum Service Temperature	Average Weight of Concrete per Cubic Foot 1.3 Mix	Average Weight per Sq. Ft. 2½ in. Thick (Note 1)	Thermal Conductivity K-factor (Note 2)
Sand	500 F	140 lb	30 lb	—
Trap Rock	1800 F	156 lb	33 lb	10.0
Haydite	2000 F	110 lb	23 lb	3.0
Crushed Firebrick	2200 F	133 lb	28 lb	7.0

Note 1. For estimating purposes add about one pound per square foot for weight of reihforcing steel.

Note 2. Btu/hr/sq ft/inch/deg F.

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The Filtration of Diesel Lubricating Oils

By **J. A. NELSON**, Diesel Engineer, Standard Oil Co. (Indiana)

THE IMPORTANCE of adequate filtration of Diesel engine lubricating oils is acknowledged by all concerned—by engine builders and operators, and by lubricating engineers. While there is no general agreement on the best type of oil filter or the most desirable installation, it is significant that oil filters are today almost as much a part of a complete engine installation as is the cooling system.

The controversy as to which type of filter is most desirable is due, in part, to the general lack of agreement on how clean an oil must be to be considered adequately filtered. There are some who feel that the filtration of Diesel lubricating oils ought to "provide a finished product that is superior to the original lubricant." In geenral, however the problem is considered solved simply by maintaining lubricating oil quality somewhere near to that of the new oil.

It is doubtful that a lubricating oil filter can do more than clean the oil. Essentially, this means the removal of such solids as dirt, fuel soot, metal particles and oxidized oil particles. The removal of oxidation products which are insoluble or only partially soluble in the oil and which are frequently acidic, reduces the neutralization number of the oil. Practically all of the commercial filters in use today will do this job adequately, providing the most desirable filtering medium for the type of lubricating oil concerned is used; providing the filter installation is correct; providing the filter is adequate in size for the engine and the operating conditions involved; and providing the filter is properly serviced.

Particle Size

It is generally considered that the presence of any particles larger than 5 microns (about 0.0002 in.) in lubrieating oil is sufficient to contribute to excessive wear. See Fig. 1. Particles smaller than this are considered unlikely to cause excessive wear. (Five microns is considered the maximum size for rouge particles used to polish optical lenses.) Many authoritative but different opinions exist as to the allowable percentage of these solid materials in lubricating oil, but in general 0.5 per cent by weight is considered the maximum desirable limit and 0.2 per cent the more desirable limit. Actually, it is not uncommon with good filtration to maintain total solid limits as low as 0.05 per cent continuously.

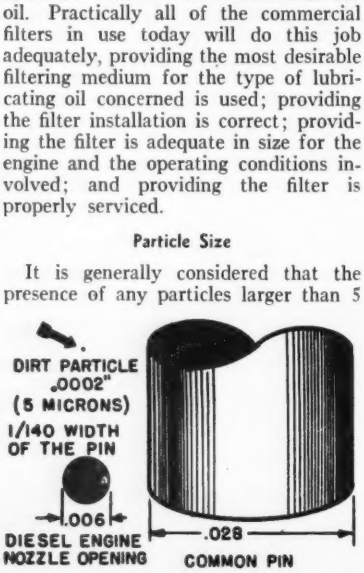


Fig. 1. Size comparison: Dirt particle—Nozzle opening—Common pin

In addition to the removal of solids many filters effectively remove water from lubricating oil. This is done by the use of heating devices connected to the engine exhaust or operating from an electrical power supply. Some filters in addition claim to remove fuel dilution, but since the upper distillation range of Diesel fuel is somewhat near the lower distillation range of Diesel lubricating oil, the problem of separating one from the other is not too practical.

Filtering Media

Filtering media can be divided into two general categories: *Absorption* type and *Adsorption* type. Such inert materials as cotton waste, paper, in fact, cellulose in any form, as well as inert diatomaceous earths, can be considered as primarily in the first category. These materials, because they are inert and because they provide an extremely fine straining action, are the type considered most desirable for use with Heavy Duty type oils. Adsorption type media include such activated materials as Fuller's Earth, Silica Gel., etc., which, in addition to providing a fine straining action, may selectively remove the more polar constituents of an oil due to a powerful surface attraction.

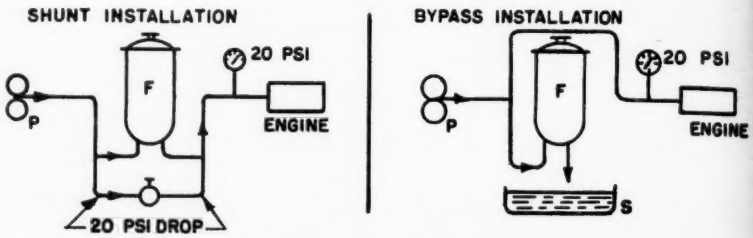


Fig. 2. Schematic diagram showing shunt and and by-pass systems of oil filtration P—Lub Oil Pump; F—Filter; S—Sump

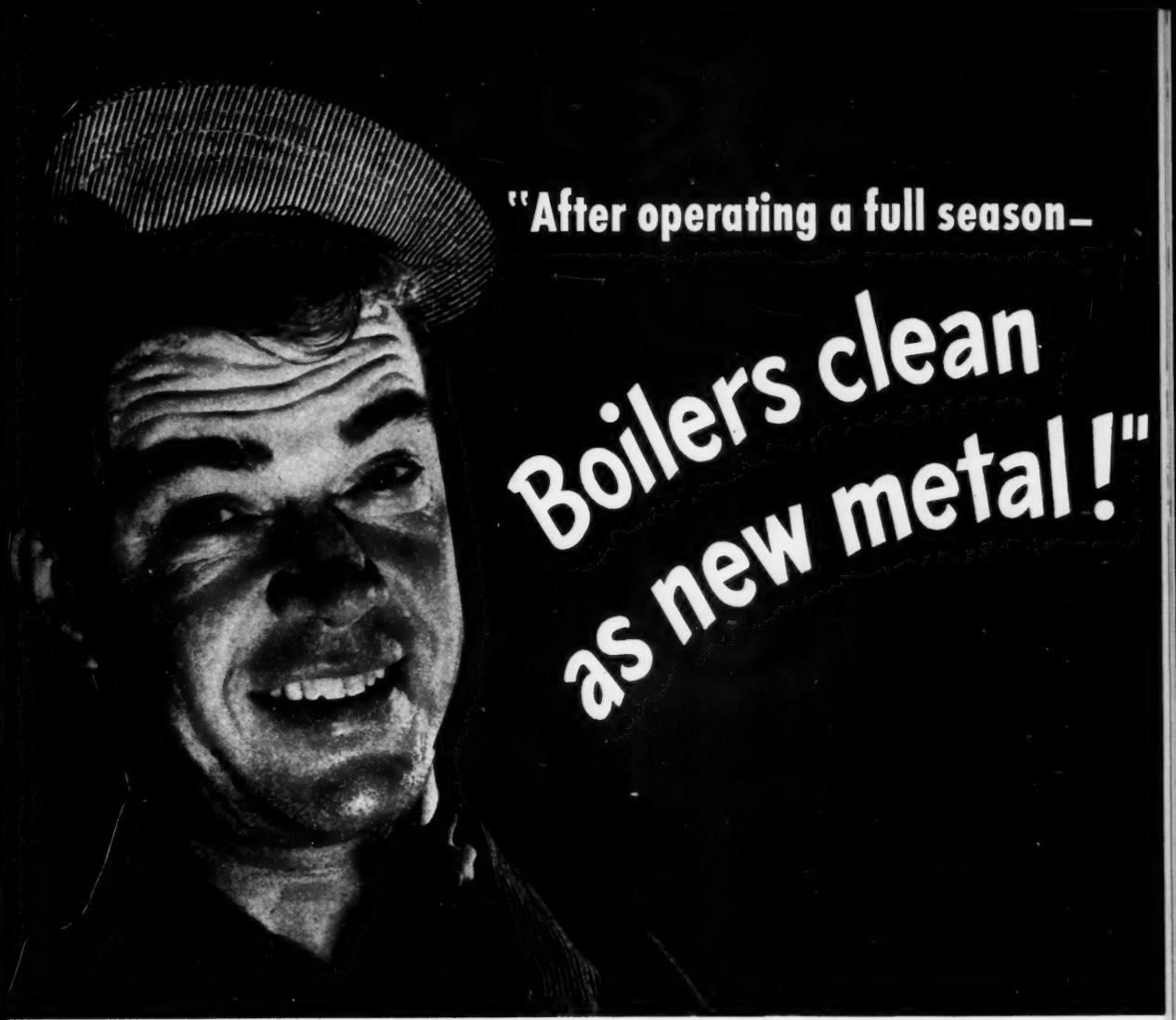
Oil filters employing adsorbent earths are entirely satisfactory for use with conventional straight mineral oils, and unless engine condition is poor, will maintain normal oil color and clarity over extremely long periods of time. These earths are, however, not satisfactory for Heavy Duty type oils because the rate of additive removal is much greater with them than with absorptive media such as cotton waste. When Heavy Duty oils are subjected to filtration through media of this type, they are soon robbed of the additives which provide the "plus values" in such products. In addition, the normal life of the filter material is appreciably shortened. In order to keep such filters working with Heavy Duty oils, it is necessary that the filter elements be changed much more frequently than when the correct type of filter medium is used.

It should be recognized that Heavy Duty oils need not be and cannot be restored economically to their original clarity by customary filtering equipment, because of the high dispersive properties they possess. Although the bulk of the suspended material can be removed readily by absorptive filtration, the remaining suspended material can only be removed by extensive laboratory equipment. There is no real need to restore original clarity in these oils because the microscopic particles that remain to discolor the oil are too small to contribute to excessive wear.

Filter Installation

Incorrect installation of the lubricating oil filter not only may prevent the

From a recent paper presented before the Missouri Valley Electric Association in Kansas City.



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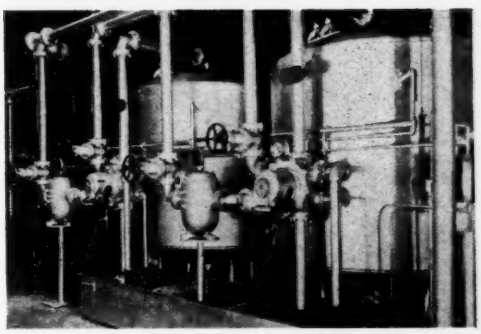

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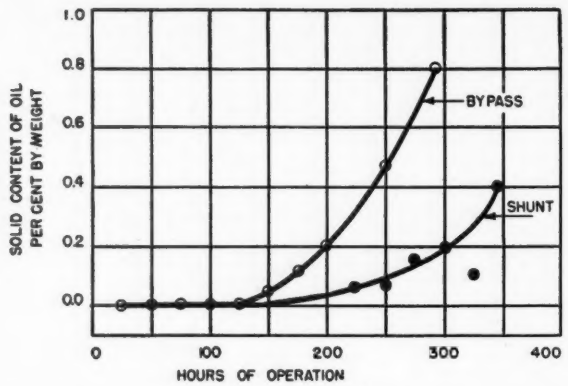


Fig. 3. Curve showing hours of operation plotted against solid content of oil for shunt and by-pass systems

filter from providing maximum service but may actually prove harmful to the engine, causing increased oil consumption, bearing failures, and other lubrication problems. Keep this in mind when considering the two general systems of oil filtration which are in use. One is the shunt system, commonly referred to as a full flow arrangement. The other is known as the by-pass system. Both systems are shown in Fig. 2.

Shunt System

In the shunt system, the filter is installed in parallel with an automatic pressure relief valve which maintains a constant pressure drop across the filter element. Generally speaking, this requires more filter capacity per unit of engine size than the by-pass system, but according to authoritative published data, it maintains cleaner oil over a longer period of time than the by-pass system. See Fig. 3. Through the maintenance of constant pressure on the filter medium, adequate filtration is maintained over a longer period of time as compared with the by-pass system where clogging of the filter element appreciably reduces the flow of oil. The generally accepted theory that low flow rates provide the best filtration has been disproved as a result of test work done at the U. S. Naval Engineering Experiment Station which indicates that the rate of solid removal from oil is chiefly dependent on the flow rate through the filter element. High flow rates subject the oil to filtration a greater number of times per hour of operation and in this way seem to provide maximum cleanliness of the filtered oil. The effectiveness of the shunt system is, therefore, apparently due to the frequency of contact of the filter medium by the oil.

By-pass System

The by-pass system of filtration is accomplished by bleeding off a small portion of the lubricating oil, passing it through a filter and returning it, usually to the engine crankcase or oil sump. In some instances, advantageous use of the filtered oil is made by returning it to some portion of the engine where lubrication through original design is inadequate and the returning filtered oil provides additional lubrication. Care should be taken that return oil is not allowed to flow onto crank throws due to the possibility of over-oiling the cylinder in line with this journal. I recall one such installation where the rings on the over-oiled piston stuck in a relatively few hours of operation.

With by-pass filtration, it is normally considered adequate to pass 10 per cent of the crankcase oil through the filter each hour of operation, thereby filtering the volume of oil in the system every ten hours. These figures are only approximate, the actual rate depending considerably on engine type and size as well as on numerous other conditions. Smaller engines operating at higher speeds require greater filter capacity and a greater proportion of the oil to be passed through the filter each unit of time.

Filters should be installed with a minimum of piping and should be located where temperatures can be maintained as high as possible (not over 200 F) to facilitate filtration. Consideration should also be given to the room necessary for servicing the filter which surprisingly enough is not done in many instances.

Filter Size

Three or four years ago the University of Nebraska prepared a bulletin covering its test work on lubricating oil filters of many types. One of the conclusions reached was that filter quality was principally dependent on filter size. Larger filters not only did a better job of cleaning the oil but continued to do a better job over a longer period of time. Good industrial filter installations are designed so that the filter medium will serve adequately over a 1000 hr period. The writer is acquainted with one filter installation, which has proved extremely satisfactory, where capacity is such that the filter medium need only be changed every four months on a 2,000 hp engine. This covers an operating period of approximately 2000 hr.

Filter Servicing

After a filter of adequate size has been selected, properly installed, and equipped with the correct type of filter medium, it then remains for the operator to service the filter properly in order to secure the optimum results. If the filter is so designed and installed that servicing will be easy, the chances are that the operator will service it properly. Of course, if replacement of the filter medium requires removal of numerous cap screws, pipe-lines and fittings, and, in some instances electric wiring, the chances are very good indeed that the operator will permit the filter to run much longer than it should between service periods.

At the time of each filter cartridge change, it is important that the interior of the filter be thoroughly washed. Then, while the filter is open, the engine should be started, or the oil pump operated if by a separate electric motor, to determine that the oil flow to the filter is normal and that no lines are clogged.

Where filter cartridges or elements are dependent on seals of one kind or another to maintain separation between the dirty oil and the clean oil, it is necessary that these seals be replaced periodically. It is essential that the correct amount of material be used when filters are packed by hand with loose replacement material. In cases where this work must be done by unskilled employees, it is desirable that the filter medium be packed in paper sacks or cartons containing the correct amount needed. Suppliers of bulk type filter

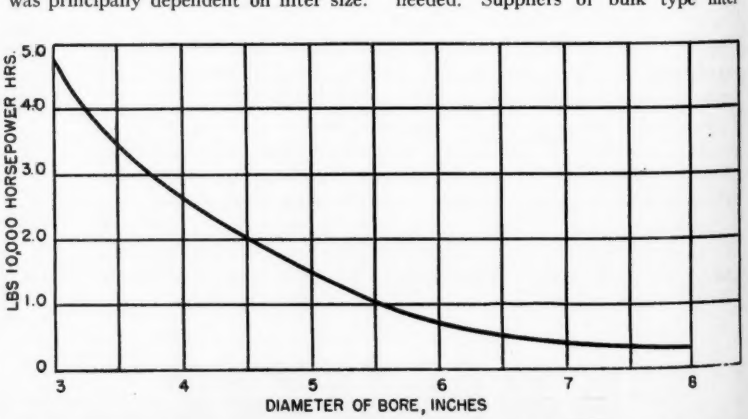
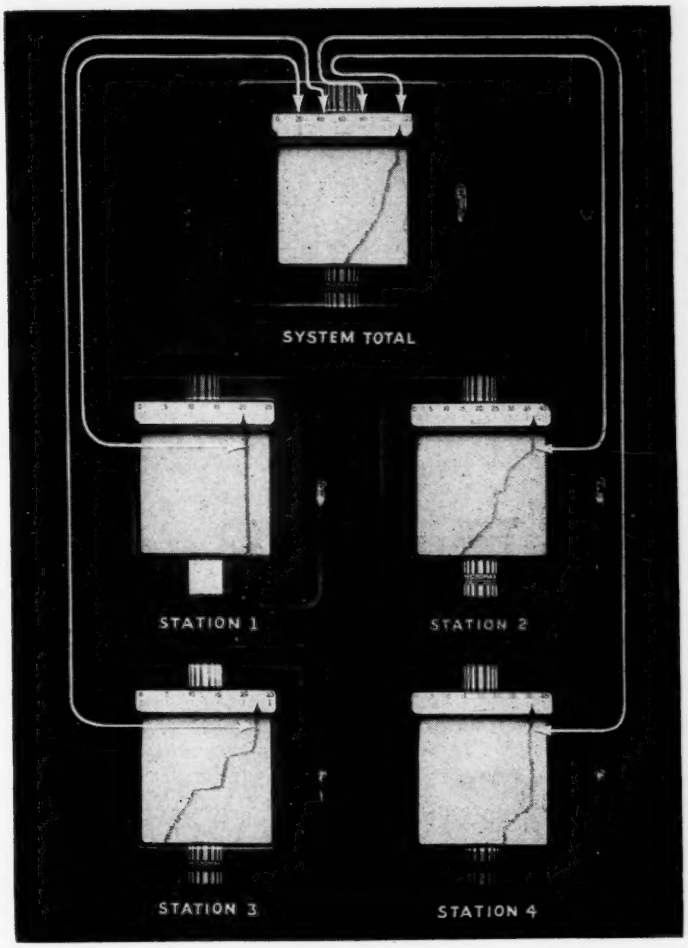


Fig. 4. Effect of cylinder bore diameter on production of solids in lubricating oil of Diesel engines
Curve is based on average data from two and four cycle engines using additive type and straight mineral oils



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medium will, upon request, arrange to provide their material packed in this fashion.

Most filter manufacturers supply filter medium under their own brands, but in the event that it is not convenient to obtain these branded materials, good results can be had by the use of long fiber, unbleached cotton waste. Cheaper grades of waste may contain fibers of rayon and scrap materials that do not assist filtration and should therefore be avoided. No. 1 cotton waste of adequate quality can be obtained from numerous sources.

Where Fuller's Earth is used to filter conventional type Diesel oils, it is essential that the oil be free of water if satisfactory results are to be obtained. Water in the oil, interferes with the action of the Fuller's Earth and quickly reduces the through-put of oil as well as the filtering ability of the filter unit. Water originating through condensation can be eliminated by crankcase ventilation and maintenance of crankcase oil temperatures at 145 F or above.

Lubricating oils should never be subjected to high temperatures (that is, about 200 F) in order to facilitate their filtration. Because of the extremely rapid rate of oil oxidation which occurs at elevated temperatures, the effective life of the oil so treated is appreciably shortened and, although the oil may appear clear in color, it will show impaired oxidation stability when subjected to laboratory tests.

By reducing the temperature at which the lubricating oil was reclaimed, engine cylinder wall varnish complaints, and varnish deposits have, in many instances, been appreciably reduced and in some cases eliminated.

In closing, I should like to summarize by repeating that oil filters are desirable on all Diesel engines and that most filters are good providing they are adequate in size, correctly installed, used with the correct filter medium, and properly serviced. I should also like to emphasize the point that adsorptive type filter media should not be used with Heavy Duty oils. While no amount or type of filtration can correct troubles due to engine design, operating methods or inadequate lubricants, the combination of a good engine, plus good operation, plus good lubricants, is definitely improved by an adequate oil filter.

Illustrations based on paper entitled "Filtration of Diesel Fuel and Lubricating Oils" by H. V. Nutt, Lieut., USNR, published in the S.A.E. Journal, December, 1944.

The Winter Meeting of the AIEE in New York

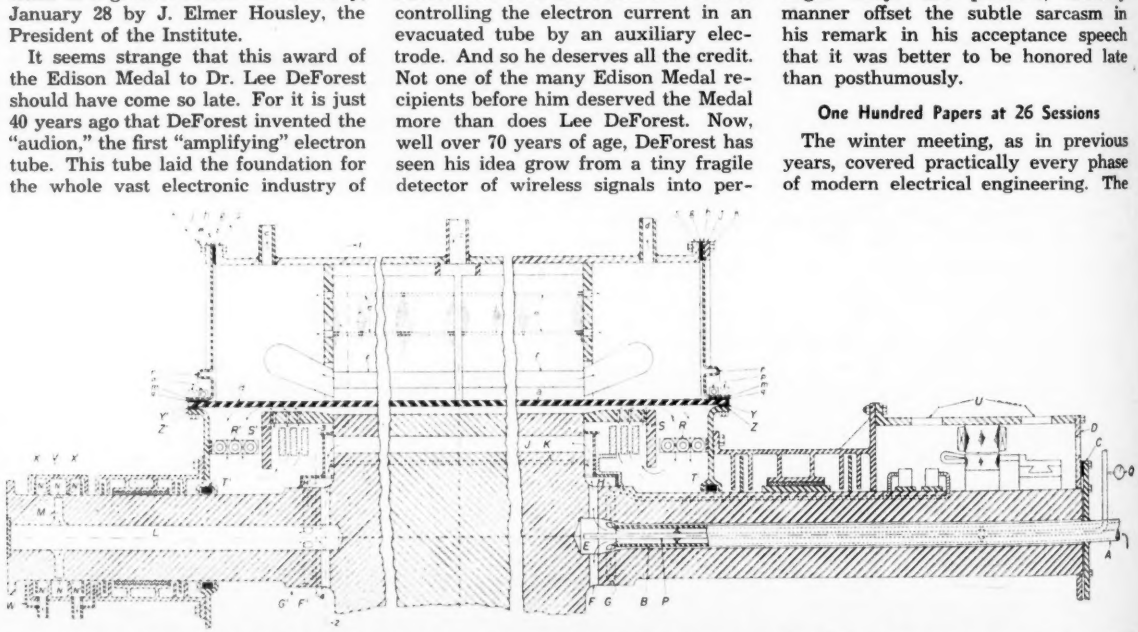
Winter meeting of the American Institute of Electrical Engineers in New York had the largest technical program in the history of the Institute. Dr. Lee DeForest awarded the Edison Medal. Electrical show held the same week an added attraction

IF THERE WAS any outstanding event at the winter meeting of the American Institute of Electrical Engineers held in New York City the week of January 27, it was perhaps the presentation of the Edison Medal to Dr. Lee DeForest. This presentation was made at a general session on Tuesday, January 28 by J. Elmer Housley, the President of the Institute.

It seems strange that this award of the Edison Medal to Dr. Lee DeForest should have come so late. For it is just 40 years ago that DeForest invented the "audion," the first "amplifying" electron tube. This tube laid the foundation for the whole vast electronic industry of today with all its ramifications into the communication field, the power industry and nuclear physics. While it is reasonable to suppose that if DeForest had not invented the three-electrode tube, someone else would have done so, the fact remains that it was DeForest who first conceived the idea of controlling the electron current in an evacuated tube by an auxiliary electrode. And so he deserves all the credit. Not one of the many Edison Medal recipients before him deserved the Medal more than does Lee DeForest. Now, well over 70 years of age, DeForest has seen his idea grow from a tiny fragile detector of wireless signals into perhaps the most powerful force in all the world. At 74 Lee DeForest is still keen and alert and if he has not acquired monetary wealth, his sense of humor and his enthusiastic interest in scientific development gives him a cheerfulness that many a captain of industry might envy. His pleasant, friendly manner offset the subtle sarcasm in his remark in his acceptance speech that it was better to be honored late than posthumously.

One Hundred Papers at 26 Sessions

The winter meeting, as in previous years, covered practically every phase of modern electrical engineering. The



Cross section of the rotor of a liquid cooled turbine generator proposed by Carl Fechheimer. Cooling liquid, which may be water, oil or other cooling agent enters hollow shaft at right and passes through passages J and K, between the rotor slots

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technical program was the largest in the history of the Institute. The program was comprised of 26 technical sessions presenting about 100 papers and 16 technical conferences. As an innovation the Edison, the John Fritz and Hoover Medals were presented in general sessions in the afternoons coordinated with technical sessions appropriate to the fields of achievements of the medalist. In previous years, it may be recalled, the Edison Medal at least was always presented at a general evening session. For the first time since the war, a group of inspection trips were arranged to plants and points of interest closely allied with the subject matter of several sessions. On the social side there was a Smoker at the Commodore Hotel on Tuesday evening, the second day of the convention. As an added attraction this year, during the entire week of the convention an electrical show was in progress at the 71st Regiment Armory at Park Avenue and 34th Street in New York. This show was staged and managed entirely by the International Exposition Co. and it proved of considerable interest to many of the engineers.

Basic Sciences

Among the conference sessions some of the most interesting were those having to do with basic sciences and large scale computing devices. There were several sessions dealing with basic sciences. The first of these was a conference on energy sources held on Wednesday, January 29. This was the first of a series of conferences on methods of producing electric power. It was sponsored by the Committee on Basic Sciences. The great impetus given to new methods of supplying electric power by developments in nuclear energy makes it necessary that all known methods of producing electric power should be reviewed in the light of present day knowledge. It was the purpose of this session on energy sources to discuss these various methods. For purposes of classification, the known means of electrical energy generation were divided into the following ten classes: Electromagnetic; Thermoelectric; Electrostatic; Electrochemical; Piezoelectric; Contact electricity; Emission phenomena; Pyroelectric; Magnetostrictive; and Earth potential.

Large Scale Computers

As already mentioned, another very interesting conference was that on large scale computing devices held on Thursday afternoon. Those of us who only *hear* of the large calculating machines such as are installed at Harvard University, MIT and the University of Pennsylvania, have only the vaguest notions of what these devices are or how they function.

It was, therefore, of intense interest to attend the session on Thursday afternoon, immediately after the presentation of the Hoover Medal to Dr. Vannevar Bush, on large scale computing devices. This session was a conference arranged by the Committee on Basic Sciences for the purpose of acquainting those who have a definite interest in these devices with their general characteristics. The developments in this field during and since the war have been tremendous and while it is true many people are familiar in a general way with the facts that such computers have been and will be made, the status and field of usefulness of the various types and what to expect in the near future is largely a matter of speculation.

Some of the machines now in operation, such as the one at the University of Pennsylvania were built for specific purposes, and while they can be used for other types of calculations, they have certain limitations.

Some of the machines now in course of design and construction will remove some of the limitations of the existing machines, but all of them still require a good deal of effort on the part of the operators in setting up the problem.

A point of particular importance in connection with the use of calculating machines was stressed by Professor Aiken of Harvard University. That was in regard to the training of personnel in using the machines. Professor Aiken said that if all the large scale calculating machines in development today went into operation, there would not be enough personnel in this country to run them.

Radar Technique in Industry

At the session on Industrial Instrumentation and Control, W. D. Cockrell of the General Electric Co. presented an interesting paper describing radar technique in industrial control. As Mr. Cockrell pointed out, for a long time industrial electronic engineers and communication engineers have felt that their circuits and techniques had little in common, that the one dealt with low frequencies and high power whereas the other dealt with high frequencies and often with signals of extremely small power. However, with the development of such special communications fields as radar and loran, it has been found that many new circuits have been adopted in the communication field which are also quite useful in the industrial field. Therefore, it is highly desirable that the progressive electronic engineer in either field keep close contact with developments in the other so he may take advantage of those which he may best use.

Modern Light Sources

Of particular interest to the illumination engineers, was the symposium on limitations of light production on Wednesday afternoon. At this symposium three conference papers were presented—one on Incandescent Illuminants by R. G. Slauer of Sylvania Electric Products, Inc.; Vapor Lamp or Discharge Sources was the subject of a paper presented by Dr. H. C. Rentschler of the Westinghouse Electric Corp.; and finally Fluorescent Sources were discussed by R. N. Thayer of the General Electric Co. In discussing Incandescent Illuminants, Mr. Slauer pointed out that the mechanical equivalent of light was 620 lumens per watt. In other words, that is the most light that one could possibly expect to get from the expenditure of a certain amount of power. This figure, however, is not attainable in practice, due, first, to the inefficiency of our lighting units and, second, to the limitations on lighting imposed by the human eye. Mr. Slauer pointed out that you could only attain efficiencies of from 200 to 620 lumens per watt if you could get people to accept different color illuminants. People inevitably compare all artificial light sources with that of the sun which, of course, is white light. Since the sun is the criterion by means of which all other illuminants are measured, it is difficult to get people to accept illumination of different color even though such illumination may be much more efficient than white light.

Mr. Slauer pointed out that despite all the improvement in the incandescent lamp, the average efficiency of incandescent lamps is still only between 2 and 3 per cent. Nevertheless he said that the illumination engineers did not have to apologize for this low efficiency, for even with all the possible improvements that could be made in incandescent lamps the efficiency would still only be around 3 per cent. As he pointed out, with so many billions of incandescent lamps in use even an increase of a very small fraction of a per cent means a great deal to the world as a whole.

Liquid Cooling of Generators

Of interest to the designers of turbine generators, was the paper by Carl J. Fechheimer on the Liquid Cooling of A-C Turbine Generators.

The foresight of a number of engineers a little less than a quarter of a century ago led to the successful development of the hydrogen cooled turbine generator. Until some 15 years ago, many operating and manufacturing engineers were skeptical about the safety of hydrogen as a cooling medium. Today these fears are dispelled and practically every large turbine generator built recently in the United States is hydrogen cooled.

As Mr. Fechheimer pointed out, by contrast present day engineers look askance at the idea of liquid cooling especially for the rotors of turbine generators.

From the standpoint of gains to be achieved provided the mechanical difficulties can be overcome, it is at least as large a step from the hydrogen cooled to liquid cooling as it was from air to hydrogen cooling. Mr. Fechheimer's paper covered the gains to be expected and he proposed methods of surmounting the mechanical difficulties. His paper was almost entirely non-mathematical, although a great deal of time had been given to calculations of 100,000 kva, 80 per cent power factor generators at 1800 and 3600 rpm.

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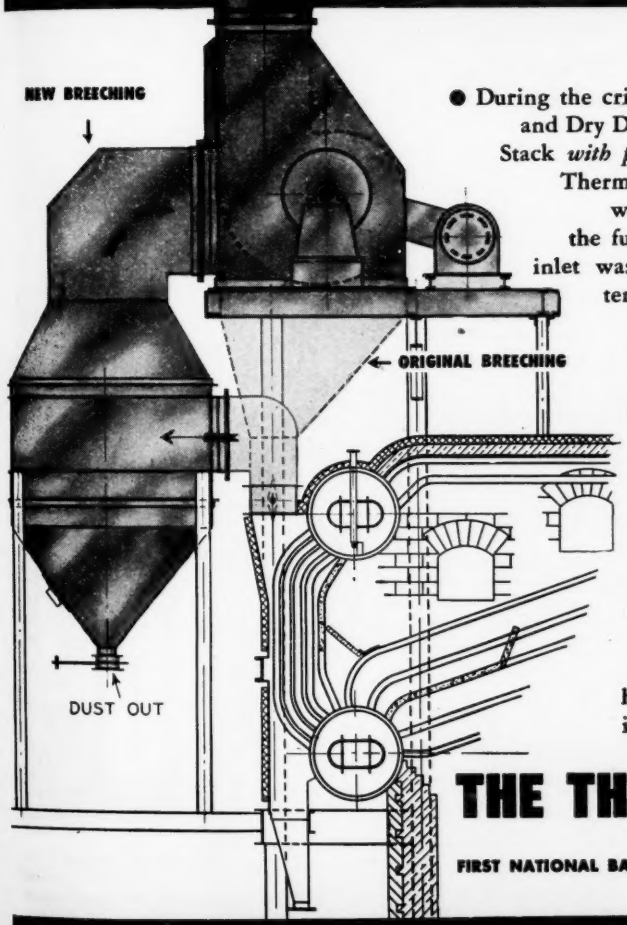

● During the critical shortage of steel, the Federal Shipbuilding and Dry Dock Company of New Jersey installed a Thermix Stack *with provisions for a dust collector at a future date.* A Thermix Fan Stack with both a side and bottom inlet was used. The side inlet was blanked off for use in the future installation of the dust collector; the bottom inlet was directly connected to the boiler outlet. This temporary breeching, from the boiler to the ID fan, is indicated in the illustration by dotted lines.

Now that steel is available, the Thermix Tubular Dust Collector has been added to the original stack installation. Placing it in operation necessitated only the removal of the duct from boiler to stack and connection of collector to boiler and side inlet of the fan. The original bottom inlet of the fan was then blanked off.

Thermix collectors have the distinct advantage of both flexibility and extremely high collection efficiencies over a wide range.

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Hell Gate Boiler Operator Observes Water Level by Television

FIRST KNOWN application of television as an aid to power plant operation has been in use for 9 months at Hell Gate Station of Consolidated Edison Co. of New York. This application is to observe the water level in one of the new large steam generating units and transmit the level indication, as actually seen in the boiler water gage glass, to the central boiler control room 325 ft away. The water column and control room are separated also by eight floors, a building wall and various other obstructions.

The device, known as the Utiliscope, was discussed briefly in *Engineers' Preview* March issue, page 7, and the accompanying views show how it is installed. It is a development by Diamond Power Specialty Corp. and Farnsworth Television & Radio Corp.

The Utiliscope shows on a screen a televised picture produced by 60 image fields. There is no measurable time lag between transmission and reception of the image. The Utiliscope is compact, weights 121 lb, includes camera with deflection unit, two small power units and the monitor or viewer. Electron tubes are standard types, easily available. The image dissector is a cold-cathode pick-up tube employing an electron multiplier for amplification of image, which provides clear color contrast. When used wth a bi-color water column, for example, red and green are presented on the monitor as white and black. The lens is easily adjustable and can be locked in place.

A standard 300 watt spotlight may be mounted to supply illumination for the pick-up unit. Aside from this, power requirement for the Utiliscope is 245 watts. It is designed for 110-v, 60-cycle single-phase operation but can be supplied for 50 or 25 cycles and other voltages. It is also designed for continuous operation at 150 F room temperature. For easy servicing, each unit may be removed from the cabinet and serviced without disturbing other parts.

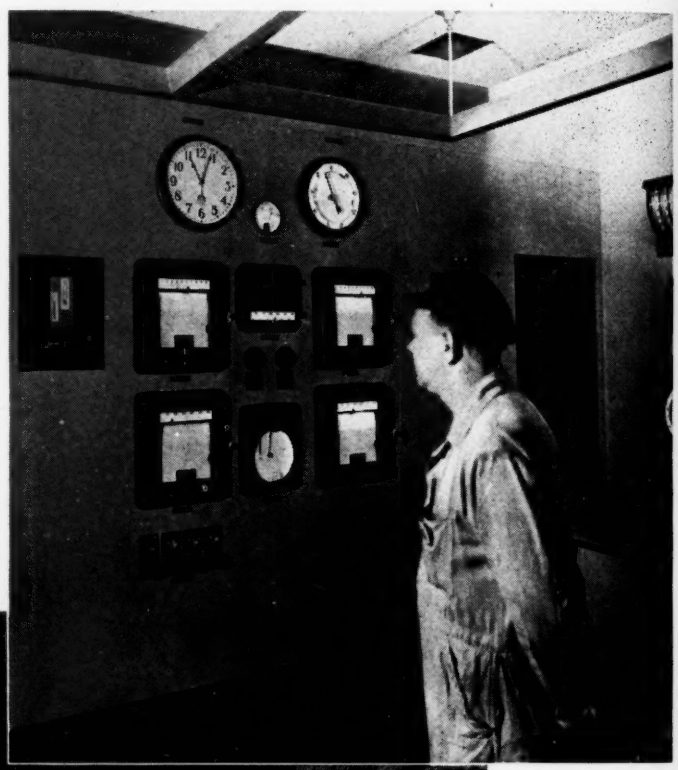
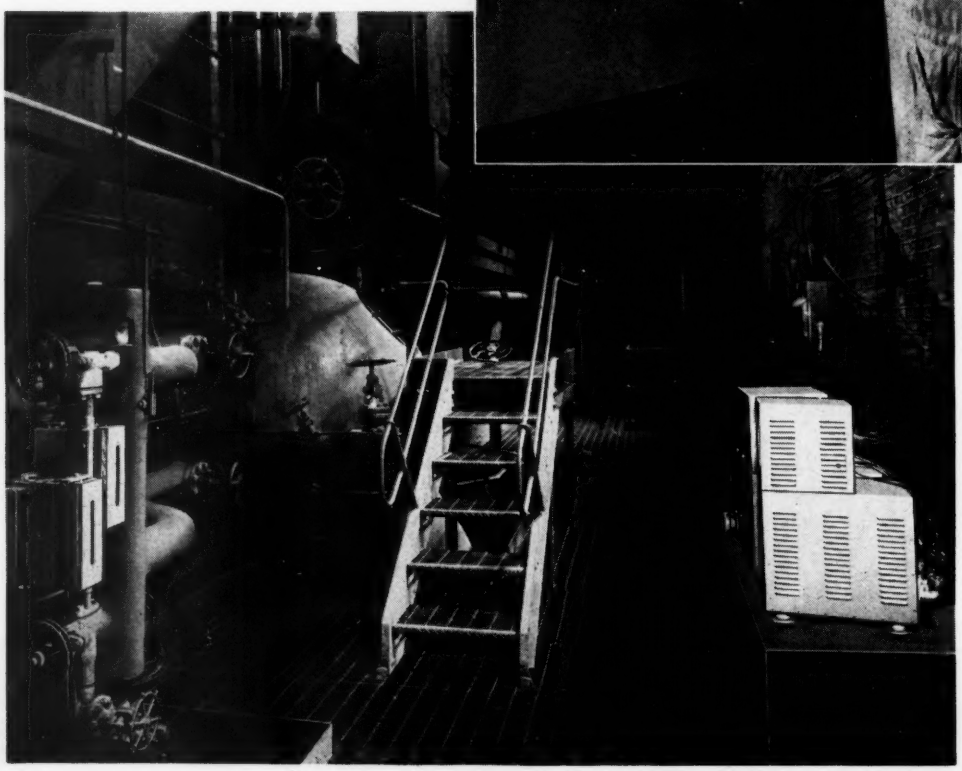


Fig. 1—Right. View in central boiler control room at Hell Gate, where monitor of Utiliscope, mounted at left of instrument panel, shows actual image of water level transmitted from water level gage 325 ft away

Fig. 2—Below. View at boiler drum level showing Utiliscope camera unit focused on boiler water level gage



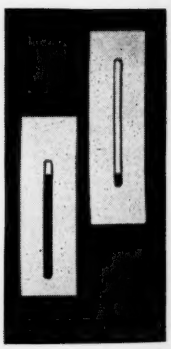


Fig. 3. Enlarged view of monitor. Screen can be seen through angle of 160 degrees. Focus, brilliance and contrast can be adjusted with screwdriver and locked

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Stanolith Greases provide two unusual benefits:

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Other advantages you can secure from Stanolith Greases may be suggested by the qualities listed at right. A Standard Oil Lubrication Engineer will be glad to discuss applications in your plant where Stanolith Greases will reduce maintenance or improve operation.

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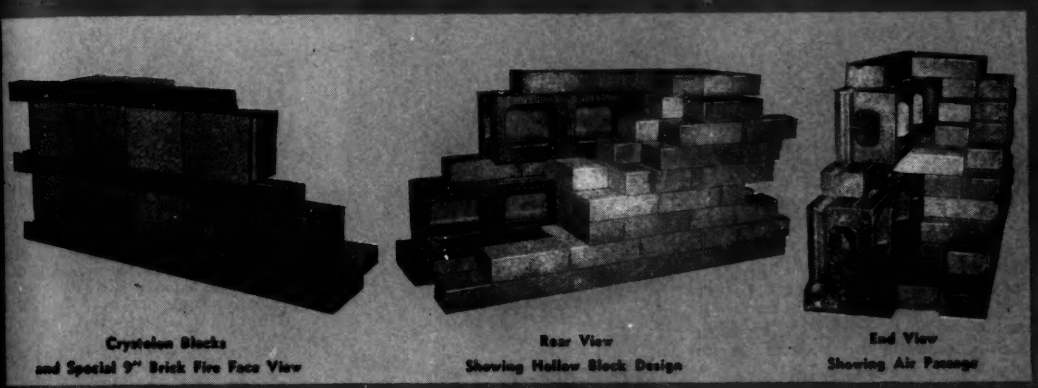
CRYSTOLON *Air Cooled* BLOCKS
for *Air Cooled* Walls in Boiler Furnaces



Crystolon Blocks and Special 9" Brick Fire Face View

Rear View Showing Hollow Block Design

End View Showing Air Passage

CRYSTOLON

CRYSTOLON is the Norton Company trademark for silicon carbide. Silicon carbide, produced in the electric furnace quite extensively as an abrasive, is also an exceptionally refractory substance. A maximum of silicon carbide and a minimum of refractory bond are used to make CRYSTOLON shapes which find successful use in boiler furnaces.

CRYSTOLON Hollow Blocks are specially designed for the scientific construction of air cooled walls in boiler furnaces. In addition to their unique design, these blocks (like CRYSTOLON Bricks for solid walls) possess the four basic outstanding qualities of silicon carbide. The result is lowered boiler lining cost:

(1) **Unusually high refractoriness.** Bonded CRYSTOLON shapes are successfullly used at temperatures up to 2900°F. (1595°C.).

(2) **Resistence to slag action.** The action of molten slag is tough on any refractory—but CRYSTOLON blocks and bricks are made so dense that slag will not take hold by penetration.

(3) **Resistance to clinker adhesion.** CRYSTOLON blocks and bricks are designed to reduce the adhesion of clinkers to a minimum. If clinkers do adhere to a limited extent, they are easily removed without any damage to the surface of the block or brick.

(4) **Resistance to abrasion.** Silicon carbide is an abrasive material of extreme hardness and, therefore, CRYSTOLON blocks and bricks show remarkable resistance to abrasion—including that caused by the moving fire bed of a stoker-fired furnace.

CRYSTOLON air cooled blocks are designed as a full block having a 9" base or as a half block with a 4½" base. They have a definite relation to the standard 9" CRYSTOLON straight brick and can be used in conjunction with it. In addition there are modifications of the 9" brick shapes, provided with standard tongues and grooves, for use in conjunction with the blocks as both headers and stretchers. The blocks are made with either a blank face or a perforated face having two or four holes.

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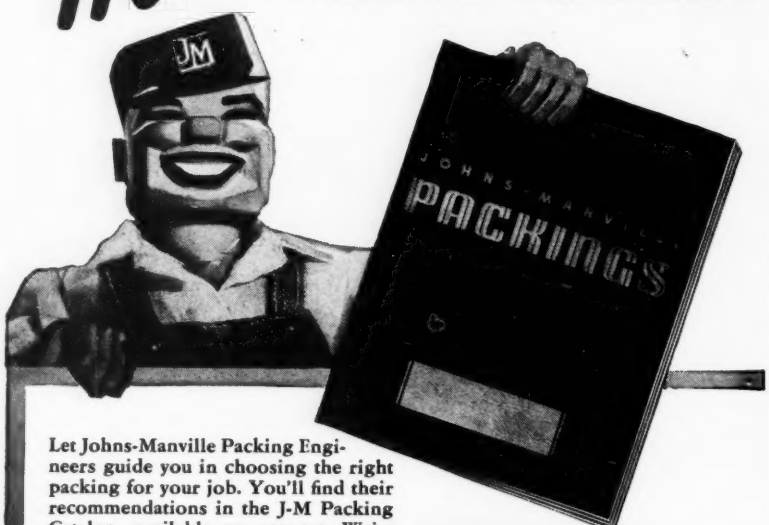

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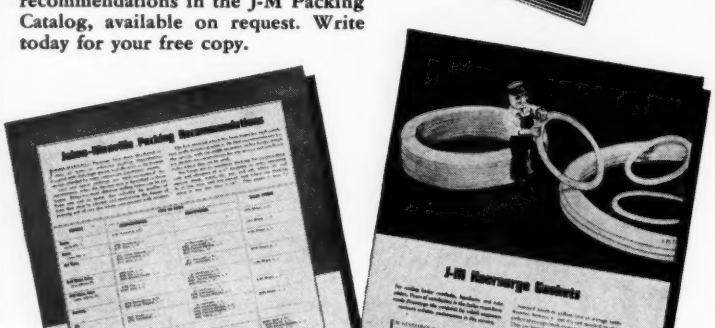

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NEWS *from* THE FIELD

FLUID FLOW LAB OFFERS RESEARCH, TEST FACILITIES

To MEET the need for testing, developing and original research on fluid flow devices and flow engineering problems, Derbyshire Machine & Tool Co., announces the availability of its well staffed Fluid Flow Laboratory. In operation for a number of years, this Laboratory has expanded its facilities to permit offering these services to industry.

Fully equipped with steam, air, and water facilities, the Laboratory is also adaptable for the handling of many other fluids. Accurate flow measuring instruments, thermometric equipment, pressure measuring devices, and other apparatus are so coordinated that any desired combination of facilities may be used as required. In conjunction with the laboratory, complete experimental shop facilities are available for the fabrication of special parts and complete working models.

All activities are under the direction of A. E. Reinhardt, former staff member at MIT, who is assisted by experienced technicians. Inquiries may be addressed to Fluid Flow Laboratories, Derbyshire Machine & Tool Company, 5252 Belfield Avenue, Philadelphia 44, Pennsylvania.

ASME BOILER CONSTRUCTION CODE

THE BOILER Code Committee of The American Society of Mechanical Engineers announces that its special committee to revise section VIII of the ASME Boiler Construction Code (Unfired Pressure Vessel Code) has just completed its work and has submitted a report to the Boiler Code Committee in draft form as a proposed revision of Section VIII, dated January 1947.

One of the outstanding features of the new draft is the development of a more logical arrangement of material, which closely follows that in the API-ASME Unfired Pressure Vessel Code: The basic minimum requirements are essentially those established in the alternate rules for unfired pressure vessels, issued as a part of the 1944 addenda to the code. Besides improved arrangement, the proposed revision embodies the following additional features: (1) Improved and extended rules for the design of formed heads under internal and external pressure; (2) provision for the design of cylindrical shells under external pressure at elevated temperature; (3) joint efficiency for fusion welded vessels established on a premium basis; (4) spot examination of fusion-welded vessels as a minimum requirement; (5) incorporation of a non-mandatory appendix as a guide for the inspection of vessels in service.

The Boiler Code Committee invites all interested persons to review the proposed revision and to submit comments thereon to the committee. The new draft is obtainable from J. W. Shields, secretary of the committee, A.S.M.E., 29 West 39th Street, New York 18, New York, at $1 per copy.

The committee plans to hold several public hearings on the proposed revision of Section VIII before final consideration for adoption. The first hearing has been tentatively scheduled for Houston, Tex., on May 1, to be followed by another in Los Angeles, Calif., on May 7. Those interested are invited to attend and to participate. Further information concerning these hearings may be obtained from the secretary of the committee.

It should be noted that the proposed revision in no way affects the forthcom-

ing issuance of the 1946 edition of the Unfired Pressure Vessel Code. There is no indication at present as to the date of final adoption of the proposed revision.

PUBLIC SERVICE CO.'S NEW 100,000 KW UNIT

CONSTRUCTION of a third 100,000-kw generating unit for installation in its new Sewaren Generating Station to meet the peak load forecast for 1950, has been authorized by Public Service Electric and Gas Co. The new installation, estimated at $12,000,000 brings to $38,000,000 the total cost of the new generating station.

Construction work is now under way on the initial step in the project, which includes two 100,000-kw units scheduled for operation in the Fall of 1948.

The newly-authorized equipment will be similar in design to that which has been purchased for the first two units. It will include a 100,000-kw, high-pressure, high temperature turbine, with a semi-outdoor type boiler, and the necessary auxiliary apparatus, and transformers and electrical equipment for making the generator output available on the 132,000-v transmission system.

Because of the abnormally long delivery schedules now required for all major apparatus, construction work is being released at an early date, to assure completion of the installation in ample time to meet the load requirement.

Since 1925 Public Service has been carrying forward a comprehensive plan of linking its generating stations in the Newark-Jersey City area and at Burlington with major industrial load areas throughout its territory by means of high-voltage transmission tower lines. These lines now extend from Jersey City as far south as Camden and westward to Roseland, where they interconnect with the transmission systems of other electric companies in Pennsylvania and New Jersey.

ORGANIZATION CHANGES AT DETROIT EDISON

ORGANIZATION changes in Detroit Edison's production department have been announced by Walker L. Cisler, chief engineer of power plants and are as follows: George A. Porter as assistant chief engineer of power plants, succeeding Walter D. Drysdale who retires after 42 years of service with the company.

Robert M. VanDuzer, Jr., has been appointed operating engineer of power plants. Virginius F. Brown has been appointed mechanical maintenance engineer of power plants. Henry E. Macomber has been appointed mechanical engineer of power plants responsible for following new construction.

William W. Brown is appointed engineer production-projects to assist Mr. Macomber in this work. Frank Nitzberg is appointed personnel assistant to chief engineer of power plants. William A. Hirt's title becomes engineer-production, load scheduling, and he continues in charge of load allocation to power plants.

Other staff members of the production department include W. A. Carter, technical engineer of power plants, George A. Chatel, engineer production-statistical-clerical; Aaron N. Simmons, electrical engineer of power plants.

OIL AND GAS POWER CONFERENCE

ARRANGEMENTS are rapidly being completed for the 19th Annual Conference of the Oil & Gas Power Division of The ASME, scheduled for Cleveland May 21-24, 1947. The Hotel Statler, in that city, will serve as the Conference Headquarters.

Registration will take place the morning of opening day, Wednesday, May 21. Thereafter, Technical Sessions are planned on the following subjects. Fuel Supplies for Internal-Combustion Prime Movers (liquids, commercial gases, by-product gases); Bearings (types, features, performance); European Developments in Internal-Combustion Machinery; and

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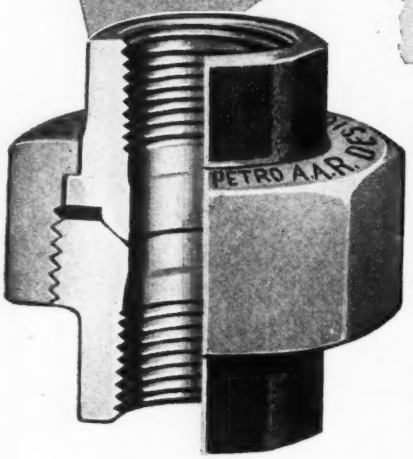

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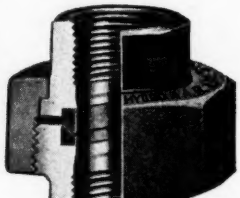

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Fundamentals of Combustion and Routine Use of the Pressure Indicator.

Ample time is to be allowed for plant inspection trips. The social aspects of the Conference center about the dinner, planned for Thursday, the 22nd, a number of social hours, and an informal evening get-together.

Manufacturers' exhibits will play a prominent part. Advance interest in this educational feature, which has grown in scope and value year after year, indicates that manufacturers of engines and related equipment will display a greater variety of items than ever before. J. M. Clark has been appointed Exhibit Secretary and will handle all details pertaining to exhibits.

Pending announcement of final details, it is urged that those planning to attend the Conference make room reservations promptly with Hotel Statler, prior to May 1, 1947.

George Codrington, prominent Cleveland industrialist and manager of the Cleveland Diesel Division of General Motors, is Honorary Chairman. Heading the overall committee on arrangements is Lee Schmeitter, O & GP chairman. L. N. Rowley, Jr. is chairman of Meetings and Papers committee and C. F. Foell, Division secretary, is in charge of publicity. Locally, the committee is being assisted by P. B. Jackson, an associate of the Division's Executive Committee, and Edward Crankshaw, chairman of Cleveland Section of the ASME.

(*Continued on page 192*)

COMING EVENTS

Power Conference—1947 annual meeting, Midwest Power Conference; to be held March 31, April 1 and 2 in Chicago, with headquarters at the Palmer House.

Society for Experimental Stress Analysis—Annual meeting of the SESA; to be held May 15 through 17, with headquarters at the Hotel Stevens, Chicago.

American Society of Lubrication Engineers—Second annual convention of the ASLE; to be held May 17 through 19, with headquarters at the Hotel William Penn in Pittsburgh.

Oil and Gas Power Division of ASME—The 19th Annual Conference of the Oil and Gas Power Division of the ASME; to be held in Cleveland, May 21 through 24, with headquarters at the Hotel Statler.

Stoker Manufacturers—Annual meeting of the Stoker Manufacturers' Association to be held June 16, 17 and 18; headquarters to be at Lookout Mountain Hotel, Lookout Mountain, Tenn.

National District Heating Association—38th Annual Meeting of the NDHA; to be held June 16 through 19 with headquarters at the Ambassador Hotel, Atlantic City, N.J.

ASTM—1947 Annual Meeting; to be held in Atlantic City, June 16 through 20, with headquarters at Chalfonte-Haddon Hall.

National Power Show—National Power Show and Mechanical Exposition; annual meeting sponsored by the National Association of Power Engineers to be held in Boston, August 25 through 28, with headquarters at the Hotel Statler.

Instrument Society—Instrument Society of America annual meeting; to be held the week of September 8, 1947, with headquarters at the Stevens Hotel, Chicago.

Instrumentation Conference—Instrumentation Conference and Exhibit for 1947; to be held the week of September 8, with headquarters at the Stevens Hotel, Chicago.

Refrigeration and Air Conditioning Exposition—Fifth All-Industry Exposition; to be held January 26 through 29, 1948 with headquarters at Cleveland Public Auditorium, Cleveland, Ohio.

Obituaries

CHARLES R. NEFF

CHARLES R. NEFF, co-founder of The Neff & Fry Co., Camden, Ohio, died at the age of 74 on January 4. He and M. R. Fry began to manufacture concrete farm silos back in 1916. Four years later, the company expanded its activities to include the manufacture of commercial and industrial storage bins of both monolithic and concrete construction.

When Messrs. Neff and Fry started making farm silos, they were both rural mail carriers, handling the silo work in their spare time. During the ensuing 30 years, the business has grown to national scope.

Mr. Neff was President of the First National Bank of Camden, in addition to being Treasurer of The Neff & Fry Co., at the time of his death. He was an elder of the Presbyterian Church and had membership in various lodges, including the Masons, in which he held the Scottish Rite Degree.

GEORGE H. DYER

GEORGE H. DYER, for many years power supervisor of Oxford Paper Co. at Rumford Falls, Maine, died after a brief illness on February 4 at the Rumford Community Hospital.

Mr. Dyer was born in Everett, Massachusetts, on May 5, 1900, and was graduated from Massachusetts Institute of Technology in 1922. After a period of employment in the operating departments of the Narragansett Electric Co., Providence, R.I., and the Duquesne Light Co., Pittsburgh, Pa., he went to Rumford Falls in 1926 as the personal representative of the late Professor Miller who was then consultant to the Oxford Paper Co.

At the conclusion of the construction then under way, Mr. Dyer remained with the paper company in charge of operation of their extensive steam and power generating facilities. He traveled much in connection with the investigation of power problems and was widely known among power and paper mill engineers throughout the East. He is survived by his widow, Adelaide Hopkins Dyer, to whom he was married in Rumford on June 24, 1933, and by his daughter, Mary Ann Dyer.

JOSEPH F. WINKLER

JOSEPH F. WINKLER, well known registered professional engineer, who specialized in refrigeration, died suddenly on January 16, 1947, in his office, 6709 Musgrave Street, Philadelphia, Penna.

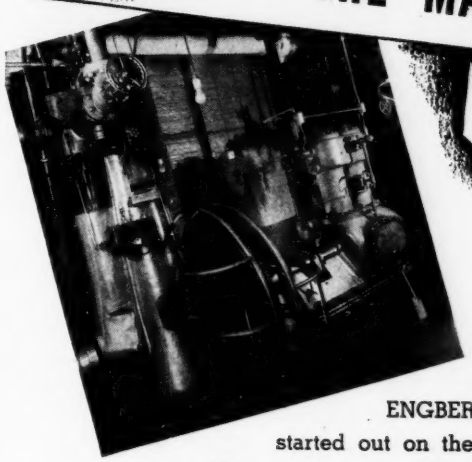
He was a descendant of a long line of engineers, and was the son of the late Theodore E. Winkler, who was among the first to introduce mechanical refrigeration into the United States, and also originated the evaporative double pipe condenser in common use today.

Mr. Winkler was constantly in touch and on the alert for modern methods of refrigeration. He also designed and built much apparatus for special applications that could not be purchased on the market here or elsewhere; this was also one of his specialties, and only recently before his death, he designed and

(*Continued on page 150*)

TROY-ENGBERG STEAM ENGINE

THE STANDBY DRIVE that soon became THE MAIN DRIVE



Here is a TROY-ENGBERG STEAM ENGINE that started out on the second team but just wouldn't stay there! This 10" stroke Type E vertical unit hooked up to a well-known ice machine was installed in SIEBEN'S BREWERY CO., CHICAGO as a standby unit for a large horizontally driven machine. After a test run it was discovered that the TROY-ENGBERG unit could carry the load with the same or less steam consumption than the larger and supposedly more economical unit. Now the TROY-ENGBERG unit carries the full load and the big unit is relegated to the standby status.

If you use steam for heating or processing, you too can probably cut steam costs, which means power costs, by installing a TROY-ENGBERG Steam Engine and using By-Product Power to drive stokers, generators, compressors, pumps or blowers.

Send for Bulletin 306.

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Established 1870
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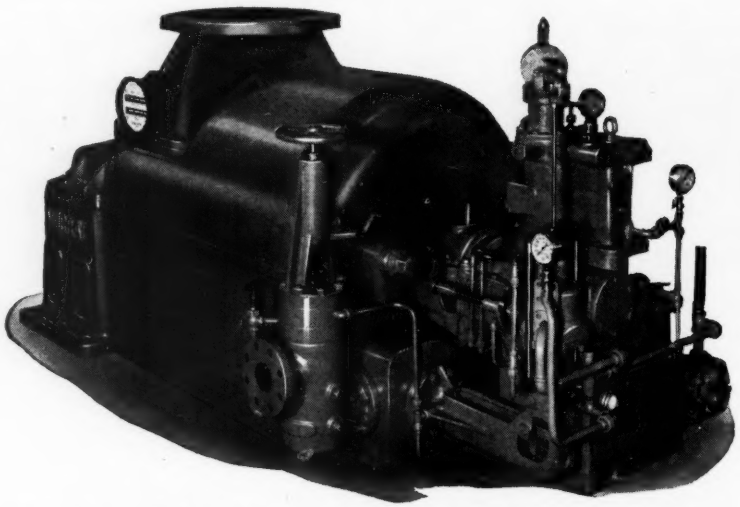
STEAM ENGINES • GENERATING SETS • GENERA



One of two MURRAY multistage steam turbines, designed to deliver 685 horsepower on steam at 110 pounds and exhausting to 26½ inches Hg vacuum, furnished to drive high speed centrifugal compressors for refrigeration in one of the most prominent Southern Hotels. A third unit has recently been shipped. Equipment includes variable speed oil relay governor, trip and throttle valve, strainer surrounding the double seated balanced governor valve, and force feed lubrication.

MURRAY
MULTISTAGE
STEAM TURBINES

★ ★ ★ ★

The complete MURRAY line of steam turbines includes all variations of mechanical drives, and turbine generator sets up to and including 3000 KW rating.

Sales Representatives for Murray products are located in all principal cities.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

HOW TO BEAT THE 40-YEAR DEADLINE

(*Continued from page 67*)

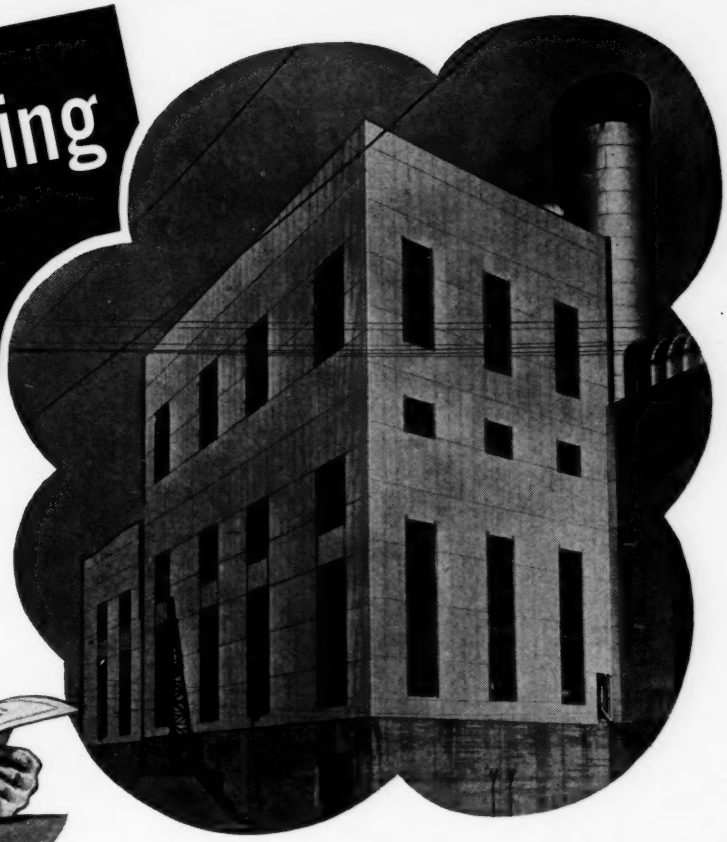
ture, and awkward in bearing. In increasing numbers, employers, seeking engineers through society placement services, stress "appearance." They may particularize as to stature, neatness, or simply say that they require a "personable" representative who will reflect credit on the organization. They make rather exacting requirements as to voice, enunciation, diction, freedom from offensive mannerisms or diffidence. A great many of them specifically refer to posture and ease of manner. Social contacts provide an incentive to cultivate some of these attributes which employers are beginning to make mandatory.

No amount of charm and polish, no contacts, however, will suffice to maintain a high rate of marketability for the engineer who has stood still so far as technological proficiency is concerned since graduation. To be sure of a job after 40—a good job, that is—an engineer must study unremittingly. He must make the most of information given in technical society meetings and journals; he must have an inquiring mind that pushes him on to investigate every phenomenon not fully understood in the course of his work. He must take advantage of correspondence, part-time and graduate courses that contribute to his mastery of fundamentals and of a marketable specialty. Not only must he keep abreast of developments in his own line; he must know what is happening outside that restricted sphere in order to learn of opportunities that may arise with technological developments.

One more investment that will pay off in increased employability is that made in a study of the business aspects of engineering—the cost angle, the impingement of social and governmental regulations on all sorts of enterprises, the engineering aspect of labor relations, and a score of special business and management problems which affect engineering and the engineer's opportunity to practice his profession with maximum satisfaction. The sort of thing that we discuss in the Chicago Technical Societies Council. These attainments also require systematic reading of non-engineering material. They lead engineers into the humanities, into sociology, economics, history, political science, business law, accountancy, and other non-physical sciences which deal with forces that have an impact on engineering, and that are affected by engineering.

When engineers really begin to understand what "maketh a full man" and when employers demand engineers who have rounded out technological proficiency with studies and activities calculated to produce that kind of employee, the man past 40 will have an actual advantage. Fifteen to twenty years, well spent after graduation, should only mature, not ossify, an engineer.

What Building Material?



K&M "Century" ASBESTOS CORRUGATED

What will determine the choice of building materials for your new plant, or remodeling job?

Will it be—

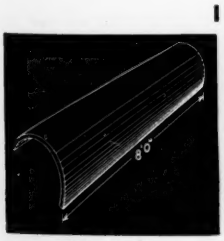
Appearance?
First cost?
Construction economy?
Speed of application?
Resistance to fire, weather, rust, other conditions?
Strength, durability?
Freedom from painting and other upkeep?

Regardless of which of those qualities you seek, K&M "Century" Asbestos Corrugated is an ideal choice, for it incorporates *all* of them in every rugged sheet. Being made of indestructible asbestos and Portland cement, it can't burn, can't rot, can't rust. Considering these many advantages, its cost is moderate, and it will pay for itself many times over in long maintenance-free life.

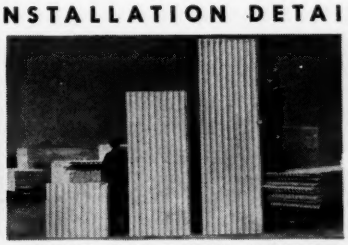
"Century" Asbestos Corrugated is easy to cut with portable electric or band saw, and easy to drill for drive screws or bolts. Cutting and fitting time is held to minimum because of 19 available sheet lengths. Salvage value is practically 100%.

If you'd like further information about "Century" Corrugated, write us, we'll be glad to help you.

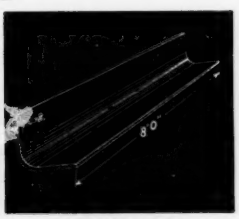
INSTALLATION DETAIL



RIDGE ROLL



VARIOUS SHEET LENGTHS AVAILABLE



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Nature made Asbestos . . .
Keasbey & Mattison has been making it serve mankind since 1873

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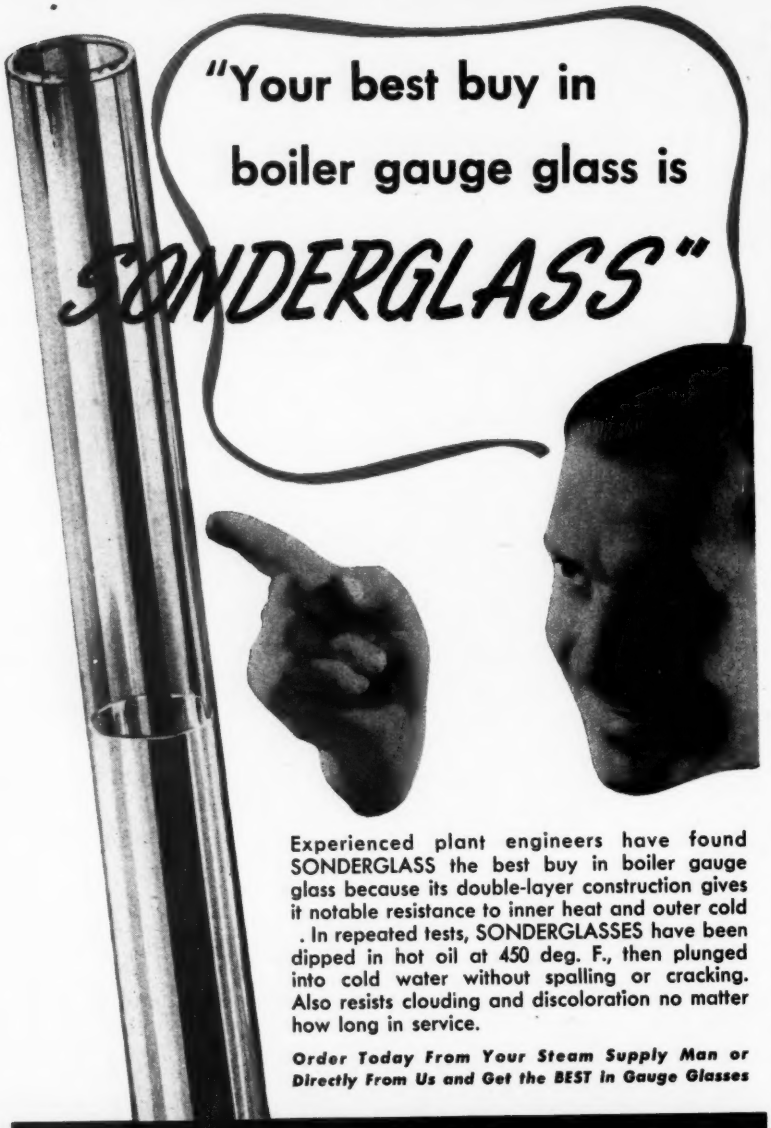
IN CANADA — ATLAS ASBESTOS CO., LTD. • MONTREAL, TORONTO, WINNIPEG and VANCOUVER

"Your best buy in boiler gauge glass is SONDERGLASS"



Experienced plant engineers have found SONDERGLASS the best buy in boiler gauge glass because its double-layer construction gives it notable resistance to inner heat and outer cold . In repeated tests, SONDERGLASSES have been dipped in hot oil at 450 deg. F., then plunged into cold water without spalling or cracking. Also resists clouding and discoloration no matter how long in service.

Order Today From Your Steam Supply Man or Directly From Us and Get the BEST in Gauge Glasses

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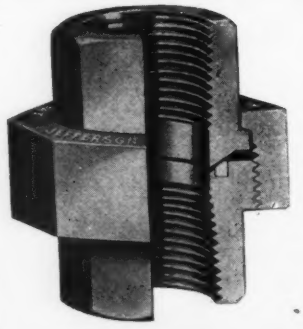
DISTRIBUTORS IN PRINCIPAL CITIES



The Feature of the RECESSED BRASS SEAT in the

JEFFERSON UNION

makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

JEFFERSON UNION CO.
601 West 26th St., New York 1, N. Y.

Factories at Lexington 73, Mass., and Lockport, N. Y.

THE GAS TURBINE POWER PLANT

(*Continued from page 107*)

liver almost full-load for about 4000 hrs per year.

How Calculate Dollar Value of Regenerator

For this example, let the shaft output be 4000 hp, and assume two fuels; (a) Diesel grade oil at 45c per million Btu; (b) bituminous coal at 15c per million Btu. As the calculations in the preceding section showed, a typical open-cycle plant can attain an efficiency of about 18 per cent, and the addition of coal-burning equipment will lower the efficiency by about one point. The plant heat rate would be about 14,100 Btu per hp hr for oil fuel, or 15,000 Btu per hp hr for coal. The fuel bill for a year, under the assumed conditions, would be about $100,000 for oil and about $35,500 for coal.

Addition of a regenerator of 50 per cent effectiveness would raise the efficiency of the oil-fired unit to about 25 per cent, lowering the heat rate to 10,100 Btu per hp hr and the annual fuel bill to $72,000. For the coal-fired plant, the efficiency would go up to about 23.5 per cent, and the heat rate would be 10,800 Btu per hp hr. The annual fuel bill would be $25,600. The first cost of a regenerator will approximate $2.50 per hp of capacity, so it is apparent that, with a high load factor, a regenerator is usually justified.

One of the more important aspects of the regenerator situation is the pressure loss which occurs on both the compressed air side and the hot gas side. Pressure loss not only reduces thermal efficiency, but—and frequently this is of greater importance—it also reduces maximum power output. The space and weight requirement of the regenerator must also be considered. Aircraft units, as an extreme example, are not likely to be equipped with regenerators, although an English prop-jet engine now utilizes one. For locomotives, the fuel saving makes the regenerator attractive on both financial and operating-range considerations.

How Regenerative and Combustive Air Heaters are Combined

Space limitations, however, have led to a new parallel combination of the regenerative and combustive air heaters. By mounting the combustive heater within the regenerative section, as shown in Fig. 8, and causing about 40 per cent of the air to pass through the former, the length and weight of the power plant can be substantially reduced. The combustor need not be insulated, since the hot exhaust gases sweep over the shell. The pressure loss in the regenerative heater is in parallel with that of the combustive heater, rather than in series, thus saving at least one valuable pound per square inch for use in the fly-ash separator. The reduction in regenerator efficiency reduces the plant thermal efficiency slightly, but the simplification of the plant more than justifies the slightly higher operating cost.

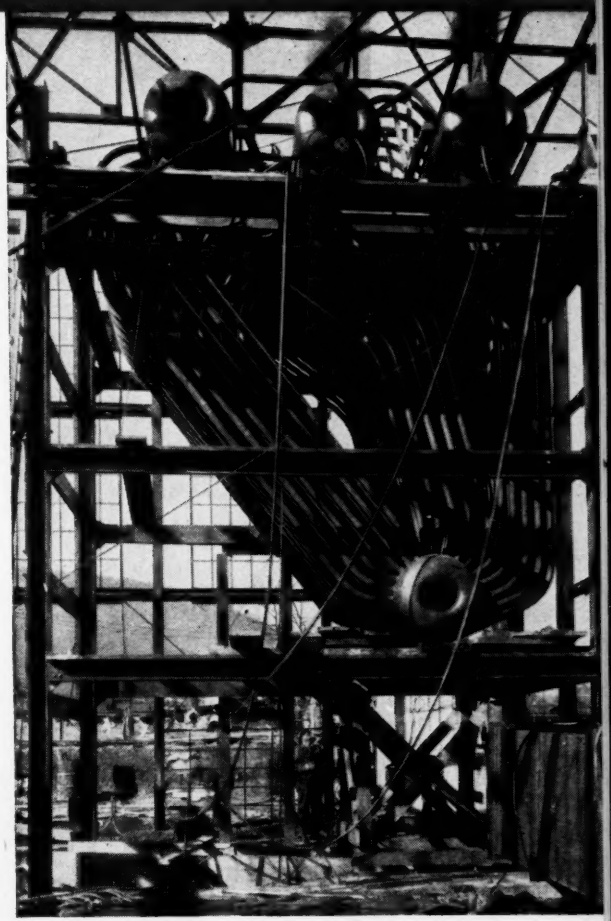
The regenerator is, in its simplest

DOWELL

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Remove Mill Scale

THE CHEMICAL WAY!



CHEMICAL CLEANING SERVICE PROTECTS NEW BOILERS!

Many power engineers have found that the Dowell chemical method of removing mill scale from new boilers before the first firing results in more satisfactory boiler operation.

Dowell engineers fill the new boiler with specially selected liquid solvents designed to dissolve the mill scale. Unless removed, mill scale may retard heat transfer, slough off particles which abrade the system during operation, and act as a base for further corrosion. Dowell brings all necessary chemicals to the job in truck-mounted tanks and furnishes pumps, mixers, heaters and control equipment.

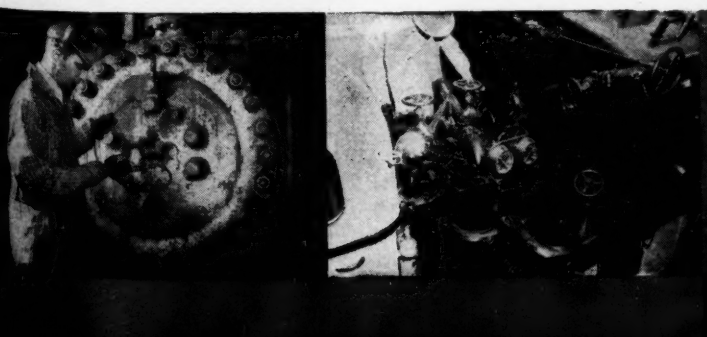
The chemical removal of mill scale *after* equipment erection can eliminate much of the extra care required in the handling of previously sand-blasted or pickled tubes. It may also substitute satisfactorily for the grease-removing alkaline pre-boil. Call or write Dowell for an estimate of the cost of Chemical Scale Removal Service for your heat exchange equipment.

DOWELL INCORPORATED • TULSA 3, OKLAHOMA

New York, Philadelphia, Boston, Baltimore, Pittsburgh, Buffalo, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, Kansas City, Wichita, Oklahoma City, Houston, Fort Worth, Shreveport, Mt. Pleasant, Michigan; Salem, Ill.; Borger, Texas; Wichita Falls, Texas; Midland, Texas; Lafayette, La.; Long Beach, Casper: Dowell Associate—International Cementers, Inc.

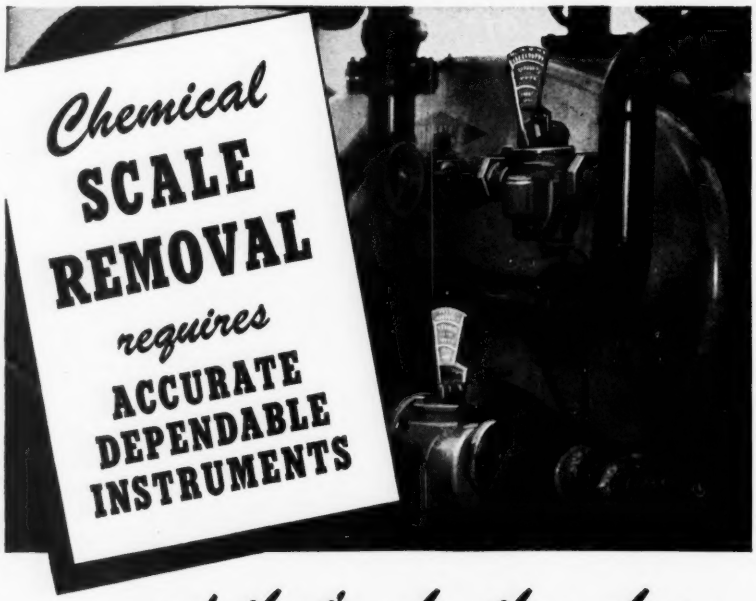
Dowell's industrial engineers are selected for experience and ability—trained in the field and in the laboratory. Dowell's field equipment is scientifically designed to control, step-by-step, the complete scale removal process. Solvents are chosen and mixed to fit each individual job.

FREE SHOWING! *New 18-minute sound slide fi illustrating the possibilities of Dowell Chemi Scale Removal Service. To arrange a spec showing call or write Dowell.*



DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE



. . . and that's why they chose

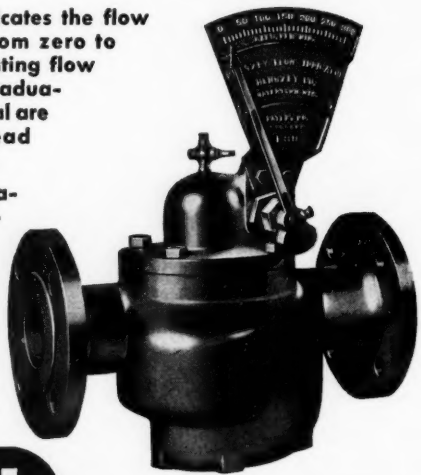
HENSZEY FLOW INDICATORS

The removal of scale from internal surfaces of boilers, heat exchangers, condensers, piping, and all other mechanical facilities subjected to scale accumulations is now being accomplished by the chemical solvent method in some of America's leading industrial plants.

This highly developed scientific system uses newly designed mobile equipment . . . and HENSZEY FLOW INDICATORS do their share by indicating rates of flow instantly and accurately under all conditions.

This rugged instrument indicates the flow over its entire range — from zero to 100% — indicating a pulsating flow exactly as it occurs. The graduations on the easy-to-read dial are uniformly spaced and read direct — without constants.

If you need accurate information on "how fast it is running"—plan for the installation of Henszey Flow Indicators. Send for bulletin FI-1 for complete details.



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form, a shell and tube air-to-air heat exchanger. The compressed air usually flows within the tubes while the exhaust hot air passes across them. The higher pressure of the air inside the tubes causes the inner film coefficient to be relatively high, while the outer film coefficient will be low. An elaborate study of regenerator design is not appropriate here, since it involves complicated heat transfer and pressure drop calculations.

The usual considerations of air-to-air exchangers suggest the use of a large number of very small tubes, because the ratio of surface area to cross-sectional or flow area obviously varies inversely as the diameter. (Surface area per tube is length $\times \pi \times$ diameter; flow area is Diameter$^2 \times (\pi \div 4)$. Increasing the number of tubes raises the first cost of the regenerator and multiplies the chance for leakage. The low outer film coefficient suggests that extended surface tubing might well be employed, but this may be objectionable when cleaning is required.

The selection of regenerator tube arrangement is largely an economic matter. Pressure drop is necessary to create the high velocity which results in good heat transfer, but the resulting loss in both efficiency and output must be considered. Careful attention is being given to surface shapes which can be formed by stamping from flat sheets and crimping. A study of the numerous publications on heat transfer with various configurations of extended surface is recommended to any prospective regenerator designers.

Regenerator effectiveness was defined in a previous section as the ratio of the temperature rise of the compressed air to the maximum possible rise, which is the difference between the temperatures at the turbine and the compressor outlets, t_{T2}—t_{C2}. Effectiveness values of 50 per cent to 60 per cent can be attained at a reasonable cost in heating surface, volume, and money. Values above 75 per cent in general are not justified, because of the greatly increased surfaces which are required.

How Combustors Are Designed

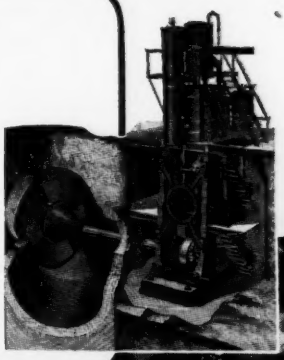
Gas turbine combustors should be viewed as direct-fired air heaters, since their function is essentially the raising of the air temperature by some 600 to 800 F. The burning of fuels requires a theoretical air supply of 750 to 770 lb per million Btu of heating value. The open-cycle gas turbine plant, however, uses some 6000 lb of air per million Btu of heat released in the combustor. This air-to-fuel ratio of about 80 to 1 is so lean that the fuel cannot possibly be burned directly in the total air supply. Instead, the air flow must be divided, and approximately the theoretical quantity must be supplied to an inner shell, within which the fuel is burned completely before the remaining air is added.

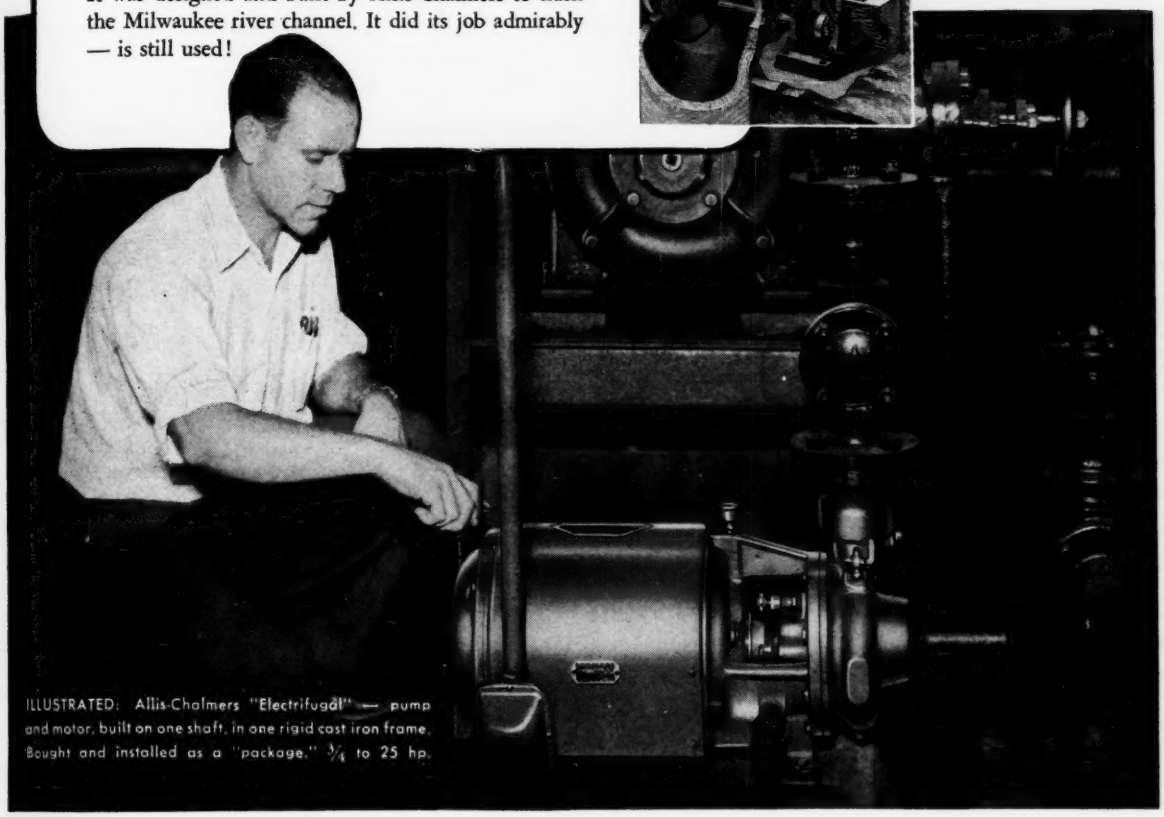
To take a numerical example, the 4000-hp gas turbine mentioned above re-

IN 1888:

This pump made a river run faster . . .

It was designed and built by Allis-Chalmers to flush the Milwaukee river channel. It did its job admirably — is still used!





ILLUSTRATED: Allis-Chalmers "Electrifugal" — pump and motor, built on one shaft, in one rigid cast iron frame. Bought and installed as a "package." ¼ to 25 hp.

TODAY: Allis-Chalmers pumps move nearly all liquids with unusual economy!

WHETHER YOU need a pump to move a river of water — or liquids high in solid content — or to develop tremendous pressures — or need just a small, compact and highly economical pump like the "Electrifugal" unit illustrated above . . . Allis-Chalmers probably makes what you want.

To fit your needs, trained A-C representatives select exactly the *right* pump and motor combination from a truly *complete* range of equipment. No need to recommend an approximation—undivided responsibility for the efficient performance of both pump and motor.

For more detailed information call your nearest A-C office or dealer, or write for Bulletin 6059-C. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2211

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—and you take a direct route to stepped-up boiler performance, for APEXIOR-coated tube and drum interiors give lasting new-metal service.

APEXIOR NUMBER 1 isolates steel from steam and water contact — permanently stabilizes boiler metal at new or newly cleaned efficiency beneath a surface that's insoluble in any boiler water.

Brush-applied to drums by hand, and to tubes by powercoater, APEXIOR holds the line against operating variables . . . adds a factor of security, for an APEXIORized boiler is corrosion-proof and deposit-resistant — economical to maintain because it stays insulation-free for better heat transfer, longer in-service time, less man-hour cost for cleaning.

Before you order a new boiler, or take an old one off the line, let us tell you more about APEXIORized metal. Write us at 1246 River Street, Hyde Park, Boston 36.

THE DAMPNEY COMPANY OF AMERICA
HYDE PARK, BOSTON 36, MASSACHUSETTS

APEXIOR

43-1-1

quires a heat release in the combustor of some 42,000,000 Btu per hour. The theoretical air requirement is about $42 \times 10^6 \times 750 \times 10^{-6}$ or 31,500 lb per hr. The actual air flow to the unit is about 50,000 cfm of free air at 70 F, 14.7 psia, or 224,000 lb per hr. The conventional combustor of the type shown in Fig. 9 would admit the theoretical quantity of air, plus an excess of 10 to 20 per cent, around the burner, while the remaining air, about 185,000 lb per hr, flows in the annular space between the outer shell and the flame tube. The cooling air keeps the flame tube and the inner shell at reasonable temperatures, and, by mixing at the end of the flame tube, reduces the products of combustion to the desired temperature.

Normal combustion is characterized by very high flame temperatures, moderate quantities of excess air, and CO_2 percentages in the range of 13 to 15 per cent. The heated air from a gas-turbine combustor, at the other extreme, rarely exceeds 1500 F even in aircraft units, and has a CO_2 percentage of only 2 to 3 per cent. The oxygen percentage, 18 to 19 per cent, is adequate to support combustion, which explains the use of direct-fired reheaters.

Effect of Pressure on Combustion

The effect of pressure upon combustion is not clearly understood. The presence of additional oxygen in a dense mixture of air and fuel allows more heat to be released per hour in a given volume; heat releases of 6,000,000 Btu per hour per cu ft of combustion volume are readily attained. Highly-volatile liquid fuels have been burned at rates at least ten times greater than the figure just mentioned, while bituminous coal in finely pulverized form has been burned at rates exceeding 4,000,000 Btu per hr per cu ft. Turbulence and high temperatures in the combustion zone are apparently essential to high rate combustion.

Ignition of the fuel in a gas-turbine combustor is commonly obtained with an electric spark. After combustion has begun, the spark can be cut off. Aircraft units normally employ a number of small unit combustors as Fig. 10 shows. Spark plugs in two diametrically oppposed units initiate combustion, and interconnecting tubes communicate the flame to the remaining combustors.

Ignition, Air Velocities, Combustor Operation

Velocities in gas turbine ducts are usually high in comparison with normal compressed air practice, in order to reduce the size of the equipment. Velocities of 200 ft per sec are not uncommon, and aircraft units employ even higher speeds. Their major difficulty is in obtaining stable ignition at high air velocities and high altitude. Power plant gas turbines do not have to utilize such high velocities, and air speeds in the flame tube can be as low as 30 ft per sec without producing excessively large combustion space.

In starting a gas turbine power plant, the compressor must be turned up to a speed of about 20 per cent of full

ENGINEERING PROGRESS REPORT # 12

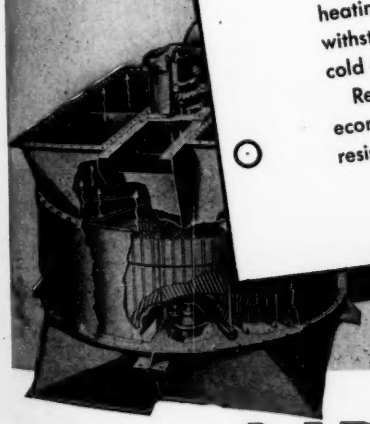
LJUNGSTROM AIR PREHEATER

CORROSION-RESISTANT ALLOY FOR HEATING ELEMENTS

The removable cold end of the Ljungstrom heating element (upper left) and sections from which the cold end has been removed for purposes of illustration.

In the Ljungstrom, the replaceable cold end is made from a special corrosion-resistant alloy that reduces maintenance and replacement. In addition, the heating elements at the cold end are made from heavier gage metal to withstand the impact of the mass soot blower and lengthen the life of the cold end.

Replacement of the cold end of the heating surface is rapid, easy and economical. Standard equipment on all new installations, corrosion-resistant cold ends can be applied to older Ljungstrom air preheaters.



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AIR PREHEATER

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NEW SAFETY IN GASKETS

WILL YOU READ ABOUT IT?

"Flexitallic" GASKETS
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for sealing steam and other fluids under pressure
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8th & Bailey Sts.

This new little book speaks of safe-sealing for fluids under pressure with the plain honesty the subject of safety deserves.

It tells with sketches and few words how the "Flexitallic" art which established itself in wide use through safe performance has now put safety on a new level.

You are not asked to abandon one theory and accept another. The book deals with a record of performance and identifies the practices that make the record possible. You are urged to believe only what pre-testing can—and will—prove to you.

We'll send you a copy

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Originators of Spiral-Wound Gasket Construction

"Flexitallic"

Gaskets of this name are manufactured only by

FLEXITALLIC GASKET COMPANY
8th and Bailey Streets Camden, N. J.

load speed. This can be done by motorizing the generator by a small starting motor, by an auxiliary steam turbine, or by an engine. As soon as the compressor begins to turn, air flow starts, and the fuel can be turned on. The ignitor usually goes into action even before the fuel is admitted, so that combustion begins at once. The fuel flow rate must be held to a low value to avoid overheating the air, but the plant accelerates rapidly as the heated air reaches the turbine. Because the combustor is very simple and symmetrical in its construction, the heating-up period can be very short. The allowable rate of temperature rise in the turbine controls the starting time. Jet units attain full power within less than a minute after the combustor is ignited. The Brown-Boveri locomotive unit can be put under load within ten minutes after the fuel is first admitted to the combustor.

Although the double-shell combustor is widely used, other types have operated successfully. The "elbow combustion chamber" of Elliott Co. has been reported to attain an efficiency of 96 to 97 per cent, with a heat release of 2,500,000 Btu per hr per cu ft. This combustor, shown in Fig. 11, is employed in the Elliott marine gas turbine plant.

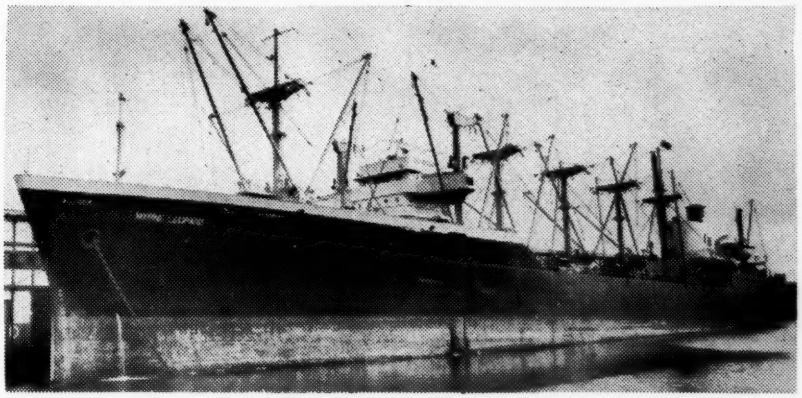
The concept of combustor efficiency requires some explanation. It is rarely possible to attain complete chemical combination of the fuel and the oxygen because of the time and space needed to make the reaction go to completion. The deposition of some unburned carbon in the form of soot is the most noticeable example of incomplete combustion. In a combustor of reasonable size, 95 to 97 per cent completeness is attainable.

The problem of insulation assumes importance in the gas turbine combustor. The final air temperature will range from 800 F at idling to 1300 F or 1400 F at full load. The pressure within the combustor will vary over the load range from 30 psia to 75 psia for a typical axial-flow plant. The value of 1300 F is far beyond the temperature at which ordinary carbon steel retain any appreciable strength. Two possible alternatives are to use expensive alloys with external insulation, or internal insulation with carbon steel as the pressure-retaining shell. Fig 9 shows a design for a power plant combustor. The flame tube might be made of type 310 stainless (25 per cent chromium, 20 per cent nickel) since it will run at about 1500 F. The inner lining, which serves to keep the insulation in shape, can be made of 18-8 (18 per cent chromium, 8 per cent nickel), while high temperature insulation is used in the annulus between the inner shell and the pressure shell, which is standard low carbon steel. Although this construction results in some design problems because of the different rates of thermal expansion of chromium-nickel alloys and carbon steel, the reduction in cost makes internal insulation a good investment.

(To be continued)

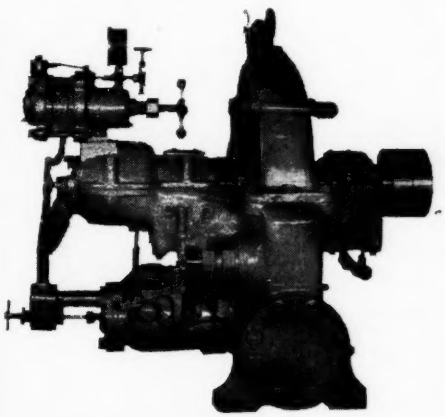
THE NEW LONDON, CONN., EVENING DAY, TUESDAY, JANUARY, 28, 1947

Freighter Discharging Record-Breaking Cargo Here



The 523-foot freighter, Marine Leopard, one of the largest freighters ever to dock here, is shown above at the state pier where 140 longshoremen are unloading a record-breaking cargo of 5,000 net tons of baled crude rubber. The ship, commissioned in 1946, picked up her cargo in the East Indies. She arrived here Sunday from New York and will remain until the end of the week.

Of local interest is the fact that the Marine Leopard has installed steam turbines driving the boiler feed pumps that were made at the Whiton Machine Co. plant here. She is one of a class of 50 so equipped. A number of the C-2 and C-3 type freighters, as well as all ocean-going tankers built during the war, were similarly equipped.



ON THE MARINE LEOPARD

24 in. Rotor—Type B K

135 lbs. Steam—10 lbs. Exhaust

4150 R. P. M.—125 H. P.

At sea a ship must always have steam.

To make steam, the boilers must always have water.

Driving the feed pumps, on sea or land, is a vitally important service (often 168 hour week non-stop) which MUST be dependable.

A steadily increasing number of

WHITON
Steam Turbines

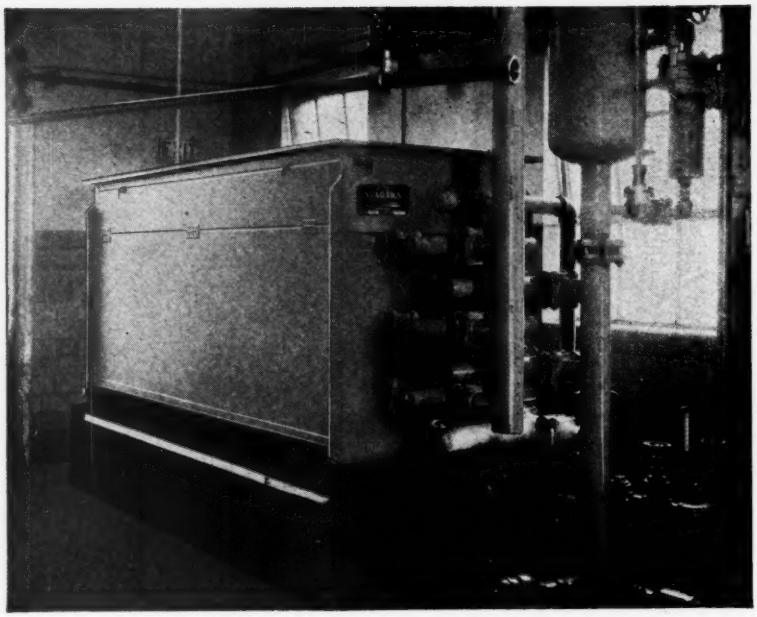
ARE DOING THIS

Ask us to submit our proposal
for your Pumping or Auxiliary Requirement

TURBINE DIVISION

The D. E. Whiton Machine Company

81 HAMILTON STREET **NEW LONDON, CONN.**



NIAGARA LIQUID COOLER
Gives High Capacity in Small Space

Cold water, chilled to 33° F., or cold liquids, or non-freezing solutions below 32° F. are produced economically by the new Niagara Liquid Cooler.

For large capacity equipment it is most compact. For example, one model furnishes 92 gallons per minute of water cooled from 45° F. to 35° F., with 28° F. refrigerant temperature, in less than 30 sq. ft. of floor space. Other models . . . from 24 to 465 G. P. M.

Extra advantages are positive temperature control; assurance of holding temperature accurately in spite of variation in cooling load; rapid chilling of the liquid; savings in power and refrigeration consumption.

Write for Bulletin No. 100-PP.

NIAGARA BLOWER COMPANY

Over 30 Years' Experience in Industrial Air Engineering

405 Lexington Ave. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

50,000-KW TOPPING TURBINE FOR SHERMAN CREEK

(Continued from page 114)

000 lb per hr against a total dynamic head of 1800 psig, at 4150 rpm.

These pumps are each directly driven by a General Electric condensing, controlled extraction type turbine. Each has a normal rating of 1357 hp at 4150 rpm with 185 psi, 485 F steam to the throttle. Steam is extracted at 90 psi for feedwater heating and the turbine exhausts to a direct contact heater at 3 psia. The turbine will develop a maximum load of 1685 hp at 4340 rpm under the same steam conditions. This capacity may be required when carrying full load with only one set of heaters in operation. These units are so designed that in case of emergency any one may be put into immediate service without warming up. However, a turning gear is supplied to rotate the unit at about 13 rpm for normal warming up periods.

There are three means provided for controlling feedwater to the boiler, automatic, remote manual and local manual. The equipment is the Bailey Meter Co. three element system, arranged to vary the speed of the boiler feed pump turbines so as to maintain a balance of water flow against steam flow, compensated by drum level variation.

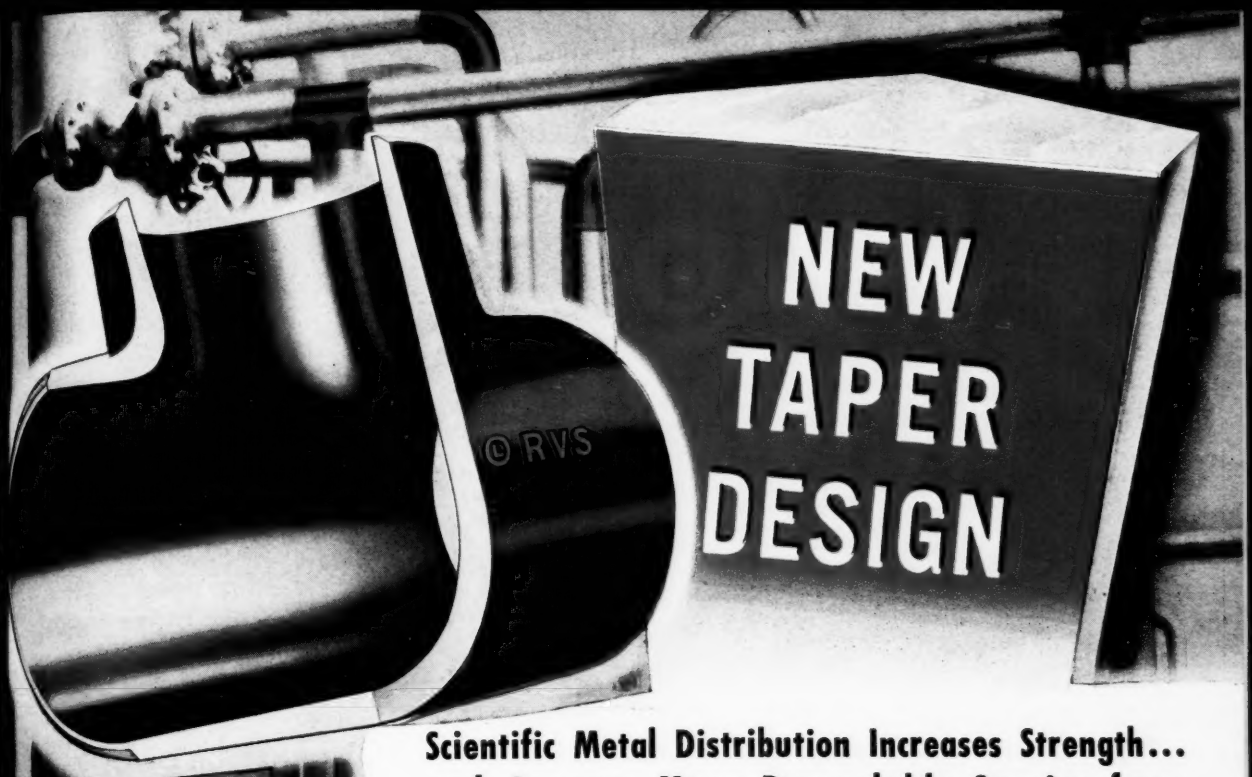
From the common boiler feed pump discharge header, the water is pumped through two parallel rows of closed heaters. Each row consists of one low pressure heater using steam at 85 psig from the boiler feed pump turbine extraction; one intermediate pressure heater using steam at 195 psig from the high pressure turbine exhaust and one high pressure heater using steam at 390 psig from the high pressure turbine extraction point. Under normal conditions the total flow of feedwater is handled through both sets of heaters. However the piping and valves are so arranged that in case an outage is necessary, one row may be isolated by gate valves set ahead of the low pressure and beyond the high pressure heaters. Full flow is then passed through one set of heaters, resulting in an increased pressure drop, but maintaining reasonable efficiency.

The feedwater heaters are the Foster Wheeler vertical U-Tube, 2 pass lockhead type, utilizing cupro-nickel tubes.

Experience with the first high pressure installation indicates that the same degree of efficiency and successful operation may be expected when this installation goes into operation.

• MAINTAIN A high feedwater temperature. Recover exhaust steam that might otherwise be wasted in a direct contact open or deaerating feedwater heater. Do not allow steam to escape to the atmosphere.

XUM



Scientific Metal Distribution Increases Strength... and Assures More Dependable Service from LADISH *Seamless Welding Tees*

By utilizing the physical principle of the taper, the new Ladish Seamless Welding Tee distributes stresses and strains uniformly over the entire design, thus assuring maximum strength at every cross section. During manufacture, extra metal is scientifically distributed to the center section and to the crotch, with the metal tapering off to the nominal pipe size at the ends. This taper enables a Ladish Tee to absorb with increased efficiency the pressures and mechanical loads which vary in intensity at different sectional areas.

A distinctive feature of the new Ladish Tee design is the long crotch radius which reduces resistance to flow and minimizes pressure loss. Full length branch outlets give greater welding accessibility and keep high welding heats from the crotch zone.

Combined with this new design, the finer, more uniformly compact metal structure of Ladish Seamless Welding Tees substantially increases their dynamic strength and toughness . . . while rigid control of melting processes gives added protection against brittleness at low temperatures, and increased resistance to distortion at high temperatures.

LADISH PROVIDES YOU ALL THESE FEATURES

- Scientific metal distribution for maximum mechanical strength.
- Assured weldability results from rigid metallurgical controls that guard against metal impurities.
- Heat code symbol is your permanent proof of the metallurgical integrity inherent in Ladish Controlled Quality.
- Long crotch radius on Ladish Tees reduces resistance to flow.
- Full length branch outlet provides greater ease in welding.
- Smooth inner surfaces reduce pressure loss—retard erosion and corrosion.

Send for this Free Dimensional Data Folder

LADISH CO.
Dept. PP-4
Cudahy, Wisconsin

Please send me the handy 10-page data folder giving dimensions, weights and part numbers of Ladish Seamless Welding Fittings.

Name.....
Title.....
Company.....
Address.....
City.....Zone...State.....

Controlled Quality FITTINGS

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES:
New York • Buffalo • Pittsburgh • Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles

DEPARTMENT OF TECHNOLOGY
BUFFALO PUBLIC LIBRARY

XUM

Here's How

ADVERTISING

by selling more goods to more people

MAKES YOUR JOB MORE SECURE

NO matter what your job today, it depends on "good business." And someone has said that in the American business system, nothing can be accomplished until "something is sold."

You know the truth of this. Falling sales mean pay cuts, layoffs, fear. Increased sales mean better pay, promotions, more security in every job for every man.

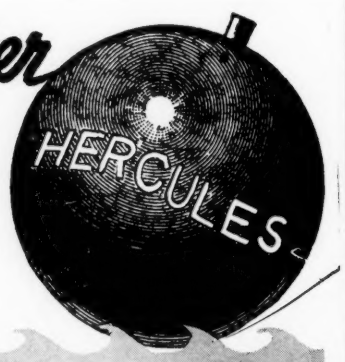
Advertising is the low-cost, efficient way to sell goods. Advertising is the spark plug of business. So advertising, by selling goods, makes your job, your home, your income *more secure!*

Other Ways Advertising Helps You:

1. **Brings you better goods for less money.**
2. **Makes shopping more pleasant and easier.**
3. **Has given us the world's highest standard of living.**

Power Plant Engineering

they Last Longer



Seamless Copper Construction

Withstand 350 lb. working pressure

Standard shapes to 10 in., also special shapes to order

Tell us about your water float problems

HERCULES FLOAT WORKS
200 Franklin Street, Springfield, Mass.

FOR TANKS AND HEATERS — SPECIFY HERCULES FLOATS

(*Continued from page 137*)

built a system for the liquefication of pure fluorine gas.

He is survived by his wife, Alma Stamberger Winkler, three sons, John, Robert and Fred and a daughter, Mrs. Frederick R. Loofbourow of New York, and four grandchildren.

MANUFACTURERS' *News*

PEABODY C.E. TO STUDY EUROPEAN INSTALLATIONS

R. C. VROOM, Chief Engineer of the Peabody Engineering Corp., New York, sailed for Southampton, England, recently on board the Queen Elizabeth.

He plans to inspect Peabody oil and gas-burning installations in England, the Continent and the Near East. Mr. Vroom will be accompanied on this part of his trip by O. Milne, Managing Director of Peabody, Ltd., London. Together they will visit the various Peabody representatives in that part of the world to acquaint them with the recent advancements in the design of Peabody equipment. While in these countries, Mr. Vroom will confer with leading engineers in the power and oil refining industries.

MARLEY OPENS L.A. OFFICE

THE MARLEY CO., INC. of Kansas City, Kans., announces the opening of a Los Angeles office at 303 Continental Bldg., 408 S. Spring St.

Arthur C. Elias, Factory Engineer, supervised the opening of the branch office during the latter part of January. The new office will serve greater Los Angeles and all of Southern California. Other sales offices and representatives of the Marley Co. are located in principal cities of the United States.

Mr. Elias entered the Kansas City office of the Marley Co. in August, 1946, after 3 years service as an officer with the navy in the Philippines, Chinese, Japanese, and Okinawan theaters of operation. He received his B. S. in Chemical Engineering from Worcester Polytechnic Institute at Worcester, Mass. in February, 1944.

PENNSYLVANIA FLEXIBLE OPENS L.A. OFFICE

THE PENNSYLVANIA Flexible Metallic Tubing Co. opened a branch in Los Angeles on February 1.

The new branch will be under the supervision of Arnold J. Dovey, who has been a sales executive with the firm since 1939. His new territory will be from the Mexican to the Canadian borders, and as far east as Salt Lake City.

The branch will be known as the Pacific coast division of the Penflex Sales Co., sales organization of the Pennsylvania Flexible Metallic Tubing Co., with headquarters in Philadelphia.

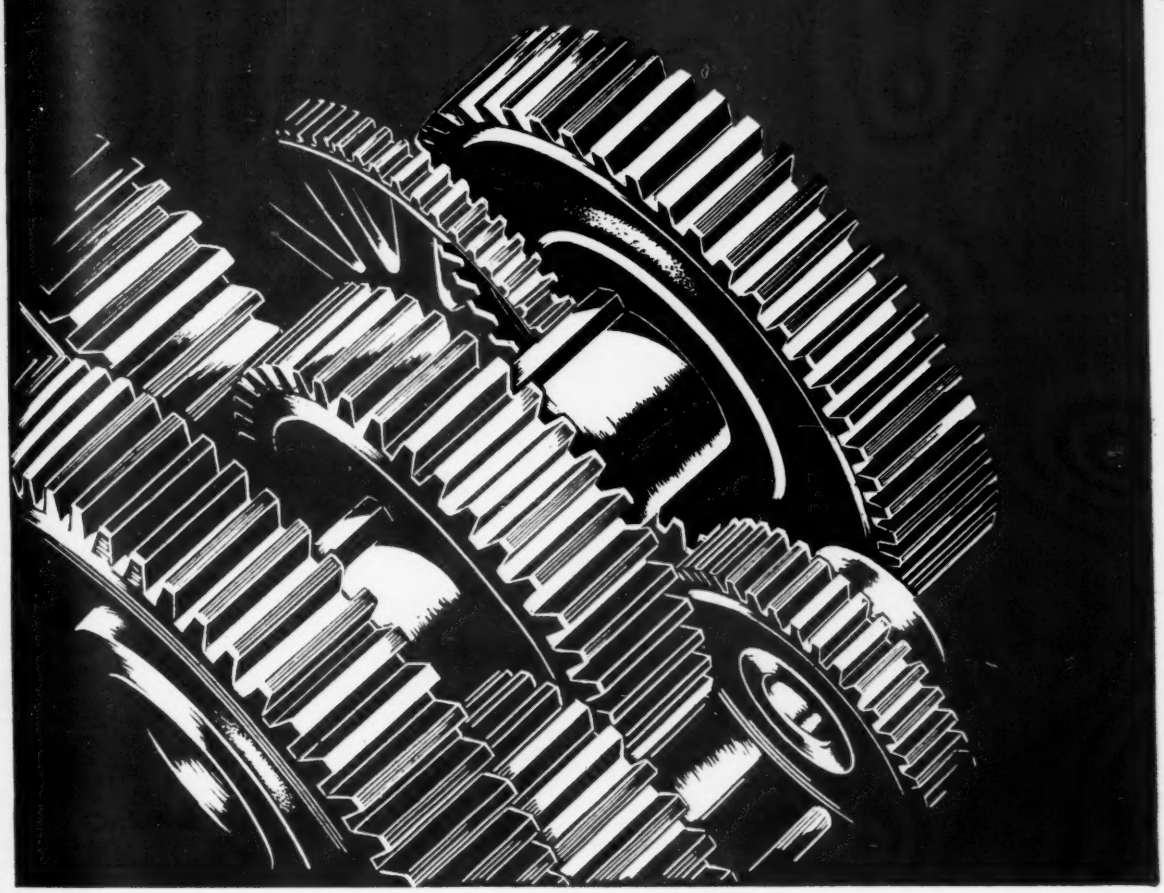
ALLOY STEEL ANNOUNCES CHANGES

HERBERT V. EVANS, JR., and H. C. Grieme joined the sales department of Alloy Steel Products Co., Linden, N.J., since the start of the year.

Mr. Evans began his career in the steel industry with Lebanon Steel Foundry. After his return from service in the Army Air Forces he represented Anticorrosive Metal Products Co., Inc. in New England.

Mr. Grieme, with Bureau of Ships, U.S.N., during the war, previously was engaged in purchasing work with Chem-

FOR INCREASED PRODUCTION... LOWER OPERATING COSTS...



choose Tycol engineered lubrication!

TYCOL
INDUSTRIAL LUBRICANTS

**Boston • Charlotte, N. C.
Chicago • Detroit
Pittsburgh • Philadelphia
Tulsa**

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE • NEW YORK 4, N. Y.

Now more than ever before it is essential to use the best lubricants available – for maximum . . . top efficiency . . . lowest operating cost. That's why more and more operators are choosing Tycol *scientifically engineered* oils and greases.

Whatever your lubricating need – for mine car or tipple, textile loom or spindle, stationary Diesel or locomotive, steam engine or turbine . . . for extreme pressure, high or low temperature, heavy duty, high speed, or any other service condition – there's a Tycol oil or grease exactly suited to your specific need.

Let us prove Tycol *Engineered* Lubrication efficiency to you . . . show you the extra value in every measure of Tycol oil and grease. Write, or wire your nearest Tide Water Associated office for the facts.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

Oscillation - Grinding on Machines of Dart's Own Design

Testing a Dart Union With Air, Under Water

You Get More From DART UNIONS Because We Put More Into Them

The Union with 2 Bronze Seats Ground to a True Ball Joint

Because Dart Unions have two bronze seats which have been precision-ground to form a true ball joint, they close easily for a drop-tight connection—uncouple without damage whenever needed in another location.

Bodies and nuts are of high-test, air-refined malleable iron—are practically indestructible. Ask your supplier for a Dart demonstration.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE 5, R. I.

ical Construction Corp., H. K. Ferguson Co. and Campbell Soup Co.

CUTLER-HAMMER'S NEW APPOINTMENTS

CUTLER-HAMMER, INC., Milwaukee, has just announced the following changes in the company's executive organizational group: J. C. Springer has been elected Treasurer. Mr. Springer is also Assistant Secretary and was formerly Manager of the company's Credit and Collection Department.

J. C. Borden has been appointed Comptroller. Mr. Borden has for several years been active on special company assignments and was Manager of the Contract Termination Division of the company. B. M. Horter is now Director of Purchases. Mr. Horter who was former Purchasing Agent for the Milwaukee factory will be in charge of purchasing for all the company's plants.

Rex Davies has been appointed Manager, Credit and Collection Department. Mr. Davies was Director of Priorities for the company during the war and has been on special assignments for the company since then. H. F. Vogt, who has resigned as Vice President and Treasurer, continues as Chairman of the Executive Committee comprising Mr. Vogt, F. R. Bacon, Chairman of the Board, and G. S. Crane, President.

According to G. S. Crane, President, these changes have been in preparation for some time.

LIQUID CONDITIONING APPOINTS REPRESENTATIVE

LIQUID CONDITIONING CORP., Linden, N.J., has announced the appointment of Engineering Sales Corp., Boston, Mass., as its New England Representative.

The president of Engineering Sales Corp. is Fred S. Gibbs, who has had several years of water treatment experience in the New England territory, and for the last seven years has been New England District Manager of a prominent manufacturer engaged in water treatment. Engineering Sales Corp. is located at 308-9 United Bldg., 43 Leon Street, Boston 15, Mass.

ARMSTRONG OPENS NEW INDUSTRIAL ADVERTISING AGENCY

JOHN R. ARMSTRONG, who has been identified with industrial advertising in Chicago for the past seventeen years, announces that he has opened an office in that city under the name of Armstrong Advertising Agency, to offer specialized industrial advertising and marketing counsel, commencing about April 1. This announcement follows his recent resignation from the firm of Russell T. Gray, Inc., Chicago, where he was employed before and after World War II as an account executive and vice president.

Mr. Armstrong is a graduate of the mechanical engineering school of Purdue University and worked as a development engineer at the Western Electric Co. prior to entering editorial and advertising work in Chicago in 1929. During the war he served on the staff of the Coast Artillery School at Fort Monroe, Va., and at present holds the rank of major in the coast artillery reserve. For work in developing an emergency method of artillery fire control at the school, he was awarded the Army Commendation Ribbon.

In the industrial advertising field, Mr. Armstrong has been active in handling well-known midwest electric meter, gear, boiler, stoker, steam trap, steel storage tank, automatic valve, and machine tool accounts.

G.E. BUYS WAR PLANT IN LOWELL

THE GENERAL Electric Co. Appliance and Merchandise Department has purchased a 437,000 sq ft factory in Lowell, Mass.

(*Continued on page 172*)

Whatever combination of conditions your springs must fight...

CORROSION · RUST · HEAT · COLD · HIGH STRESS · FATIGUE

Whatever type of spring you need...

COMPRESSION · EXTENSION · TORSION · SPIRAL · FLAT · CLIP · RETAINER · GARTER · BANANA

Consider these alloys first...

MONEL* · "K" MONEL* · INCONEL* · "Z" NICKEL* · NICKEL

There is no need to put up any longer with repeated troubles that can be avoided by using INCO Nickel Alloy springs for corrosive conditions and elevated or sub-zero temperatures.

Now, rustless, high-strength springs can be made of five different INCO Nickel Alloys to withstand corrosive attack and temperatures up to 750°F. or even higher.

And they cost so much less than special alloy springs that it is practical to use them for any application where heat, corrosion or fatigue are causing you trouble with ordinary spring parts.

NICKEL (INCO TRADE MARK) ALLOYS

HERE'S A CHANCE TO GET RID OF THE SPRING PROBLEM THAT HAS BEEN BOTHERING YOU

Send for "ANALYZING THE SPRING PROBLEM." When you get this simplified worksheet, jot down the data about your spring problem and what you want in a spring. The information you supply, plus our service records and test data, will enable us to judge which material can be recommended for your particular service. Then, we will cooperate with your spring manufacturer to work out the answer to your problem. That is all you need to do. Write today for "ANALYZING THE SPRING PROBLEM."

HELPFUL BULLETINS

(*Continued from page 52*)

POWER TRANSMISSION

38 **Coupling Selection Guide Book**—Selection of just the right coupling for the job is made easy with this recently-issued 32-page guide book, Bulletin 4100. Among the data which make the job easy are the following: A load classification table for common coupling applications; simplified selection tables which are used to supplement the above-mentioned load classification table; Two pages of formulas for selecting couplings (a) for motor and turbine drives and (b) for engine drives. Full pages of service factor tables and tables of "K" factors are given. Tables of dimensions for couplings and a table of "Recommended Specifications for Bore Dimensions" are presented. Complete catalog information on the company's line of couplings is included. The Falk Corp.

39 **Speed Reducers Engineering Handbook**—This 144-page handbook on speed reducers presents information on every phase of speed reducing problems. Typical are sections on selection of speed reducers, design and construction, lubrication and oil retention, complete dimensional information, prices and dimensioned drawings, shaft arrangements, horsepower and torque output ratings, overhung load capacities. One complete section of the booklet covers differential speed reducers, design, construction and selection. Other data includes information on how to meet overhung loads, and on mountings and installation. Many pages of engineering formulas and tables are given. The booklet is spiral-bound in a heavy paper cover. Winfield H. Smith Corp.

DIESELS

40 **Packing, Diesel Products**—A new 46-page catalog, divided into two sections, has just been issued by this company. The first section describes standard piston rod packing assemblies, valve stem and tandem rod packing assemblies, steam pipe slip joint assemblies and packing accessories. A blue print to facilitate accurate order of desired parts and assemblies for the packing is a convenient feature. The second section is devoted to descriptions of a "Bearing Watchdog" system (described as extra protection for Diesel engines) valve spring depressors, and a sleeving process. The bulletin is attractively printed in two colors and is bound in a loose leaf folder. Paxton-Mitchell Co.

41 **Industrial Marine Diesels**—This 64-page Bulletin 5218 is a compendium of the construction and operating characteristics of the company's line of industrial, marine and automotive Diesel engines. Curves showing fuel consumption, torque and horsepower at various speeds are given for each of the various series. Cummins Engine Co., Inc

MISCELLANEOUS

42 **Lubrication Publication**—The January issue of "Lubrication," a technical publication devoted to the selection and use of lubricants, contains an unusually comprehensive article on oil purification, filtration and reclamation. Excellent line diagrams, photos of equipment and complete descriptions of each piece of equipment such as filters and centrifuges are contained in the article. Your name will be placed on the mailing list to receive this magazine. The Texas Co.

43 **Packing Rings Bulletin**—Bulletin A-909 describes the company's Vee-Flex packing rings which are pointed out as being automatic in their action, designed for obtaining maximum sealing qualities with finger-tight gland compression. The bulletin contains a schedule of ring sizes which is accompanied by line drawings. Raybestos-Manhattan, Inc.

44 **Heat Insulation**—A 4-page bulletin on heat insulation has just been issued. The bulletin shows how the insulation reduces, by condition, radiation and convection the heat loss from pipes, heaters and hot or cold air conditioning ducts. Sections of the three types of insulation are shown and a thermal conductivity chart shows the heat losses from each type. A full page of recommendations for use and application of the insulation on piping, equipment, duct systems, ovens, kilns, etc. are given. The Philip Carey Mfg. Co.

45 **Insulating Varnishes**—A 40-page booklet containing complete technical and application data on the company's insulating varnishes has just been issued. The booklet includes specifications, electrical properties, film properties, cure and aging, etc. The largest portion of the book consists of tabular material in page size. Resin and Insulation Materials Div., General Electric Co. (Pittsfield).

46 **Chimneys**—This 6 page folder tells the story of how this company's chimneys withstood the atomic bomb blast at Nagasaki. Photographic evidence is included and a statement regarding the construction of the chimneys is given. The Weber Chimney Company.

47 **Level Indicators for Bins, Silos**—Bulletin I-3 is an 8-page bulletin dealing with the company's line of material-level indicators for storage bins and silos. Operation and construction of the indicators is clearly portrayed by line drawings and descriptive material and methods of wiring are shown. One full page of drawings shows typical applications. Fuller Co.

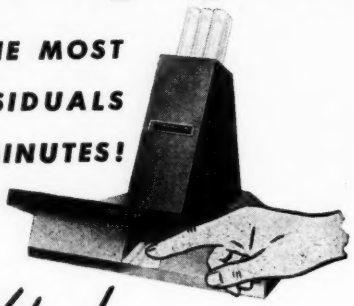
48 **Silicone Catalog**—The third edition of the Company's Silicone Catalog has just been announced. The bulletin shows how silicones are finding increasing application in diversified industrial fields due to their unique properties. Among the products covered in this third edition are compounds and greases, fluids, varnishes and resins. Physical properties of these various products are outlined and their particular advantages in industry are described. Dow Corning Corp.

49 **Heavy Liquid Spot Heater**—This bulletin announces one of the company's new products—a hot spot preheater which heats heavy liquids so that they will flow freely from bulk storage. Construction details of the heater are explained and a table shows how steam or hot water may be used as the source of heat. Rempe Co.

50 **Cafeteria Water Coolers**—A specification sheet for industrial cafeteria water coolers has just been issued. It shows the various dimensions of the unit and presents tabular material regarding the number of faucets, dimensions of supply connections and compressor ratings. A table of capacities in gallons per hour and compressors required also presents helpful information. The Heat-X-Changer Co., Inc.

With Taylor Equipment

YOU CAN DETERMINE MOST BOILER WATER RESIDUALS IN ONE TO TWO MINUTES!



There's the Value!

YOU GET . . . *Speed* . . . with a simple, 3-step operation!

YOU GET . . . *Simplicity* . . . no handling of fragile Nessler tubes!

YOU GET . . . *Accuracy* . . . liquid color standards carry an UNLIMITED guarantee against fading!

YOU GET . . . *Economy* . . . standard slides, for silica, chlorine, ammonia, pH, etc., may all be used on one single base!

YOU GET . . . *Durability* . . . sets are made of plastic, light in weight, extremely portable!

YOU GET . . . *Convenience* . . . no single standards to handle. Complete sets of color standards enclosed permanently in slides.

GET THIS BOOK!

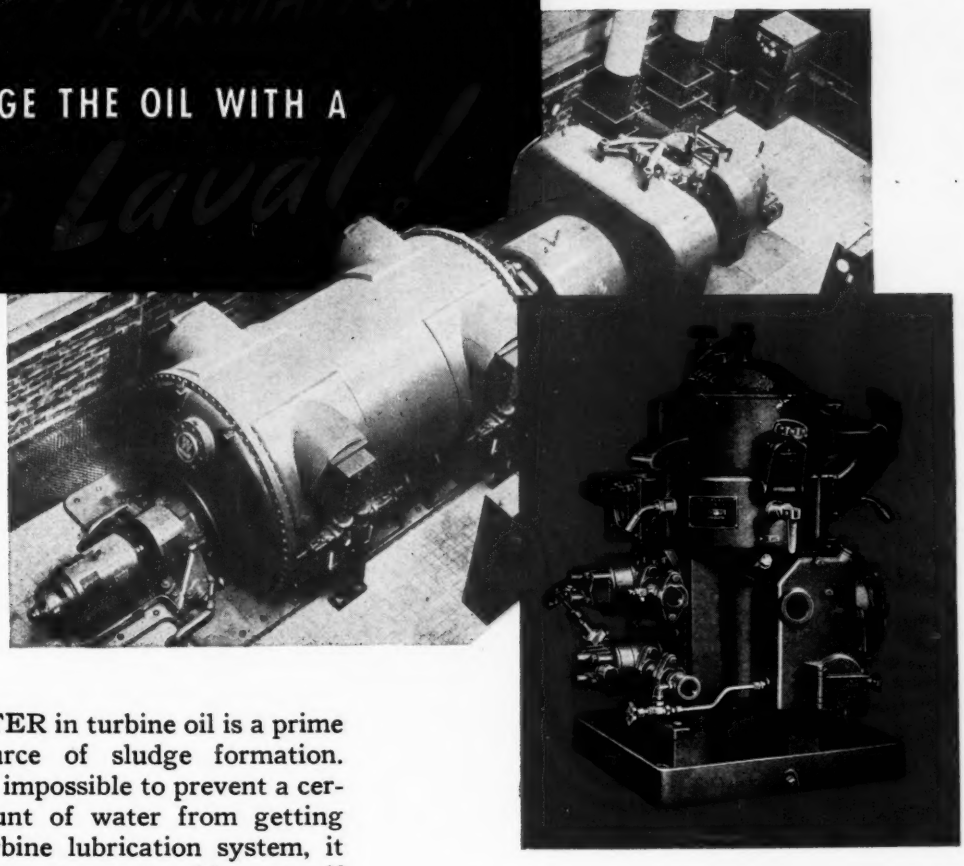
Ask for free copy of "Modern pH and Chlorine Control" . . . 88 pages give detailed information on Taylor methods and equipment . . . theory and application in 34 basic industries. Makes recommendations for many types of power plant needs. You can use it as a reference book. See your dealer or write direct to:

W. A. TAYLOR AND CO.

7301 YORK RD. • BALTIMORE-4, MD.

Want to minimize

CENTRIFUGE THE OIL WITH A De Laval!



WATER in turbine oil is a prime source of sludge formation. Since it is impossible to prevent a certain amount of water from getting ***into*** a turbine lubrication system, it is important to remove this water if sludge formation is to be minimized.

De Laval Oil Purifiers remove water from oil by means of centrifugal force, discharging the water continuously. If a sudden water leak should occur, the possibility of even more serious trouble is likewise minimized because the De Laval unit properly selected for size has ample reserve capacity to remove sudden "slugs" of water.

At the same time a De Laval Oil Purifier removes ***dirt*** from the oil, storing it out of harm's way until it is convenient to clean the bowl. Because of the design of the De Laval bowl, there is no possibility of either water or dirt recontaminating the oil that has been purified.

In short, a De Laval provides maximum protection against ***both*** troublemakers — water ***and*** dirt. Write for your copy of Bulletin TO-1.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
PETERBOROUGH
QUEBEC MONTREAL WINNIPEG VANCOUVER

OIL PURIFIERS

FOR MORE *Dependable* POWER PRODUCTION

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS

51 Steam Generators—Catalog almost completely devoted to cross-sectional drawings with accompanying listing of principal data of typical installations in rubber companies, steel works, sugar refineries, municipal plants, etc. Details of furnace water wall construction on inside back cover; 16 pages. Henry Vogt Machine Co., Inc.

52 Double-Pass Boilers—Bulletin RM-1 (6th edition); illustrates and describes this line of riveted or welded double-pass steel firebox boilers. Three full pages of dimensions, ratings and other details including dimensioned line diagrams; 8 pages. The Brownell Co.

53 Boilers, Burners, Accessories—Bulletin GC-10; condensed catalog of regular products for stationary power plants. Each class of equipment summarized and illustrated. Well illustrated with line drawings and photographs. Illustrations accompanied by brief descriptions; 12 pages. Combustion Engineering Co., Inc.

54 Standardized Boilers—Bulletin 746; 4 page bulletin presenting construction and operation information and ordering specifications for this company's Type M boilers. Bulletin illustrated, presents table of measurement and data. Springfield Boiler Co.

55 Steam Generator—Bulletin 119; company's Type S steam generator described and features of construction are pointed out. Folder well illustrated and dimensioned drawing and table of dimensions and sizes given. Union Iron Works.

PRIME MOVERS

56 Axial Flow Impulse Turbine—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. Terry Steam Turbine Co.

57 Multi-Stage Turbine—Bulletin SR-114; Casing, lagging, wheels and blades; shaft, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

58 Steam Engines—Bulletin No. 306; Engineering data; tabular material, descriptions; 8 pages. Troy Engine & Machine Co.

59 Generating Sets—Bulletin No. 108; General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

60 Stationary Diesel Engines—Dependability, adaptability of Diesel power described and the first five applications pointed out. Its economical and simple design is stressed. Advantages of company's equipment brought out; exceptionally well illustrated; 24 pages. Enterprise Engine and Foundry Co.

AUXILIARIES, ACCESSORIES

61 Strainers and Separators—Bulletin 46-50; describes complete line of company's strainers and separators. Dimensions and price lists, dimensioned drawings and photographs; tables of sizes and complete description of applications, operation and design; 16 pages. American District Steam Co.

62 Atomizing Deaerators—Bulletin 4160; 3 color drawing illustrates description of principle of operation. Advantages of deaerators are described and illustrated; marine deaerators also covered; 20 pages. Cochrane Corp.

63 Steam Condensers—Bulletin 1461 "Steam Condensers"; exceptionally well illustrated with line drawings, charts and photographs. Large proportion of the catalog devoted to engineering information such as calculations of required surface, atmospheric relief valve sizes, tube characteristics, free dry air leakage, pressure-temperature conversion tables and tables of logarithms; 46 pages. C. H. Wheeler Mfg. Co.

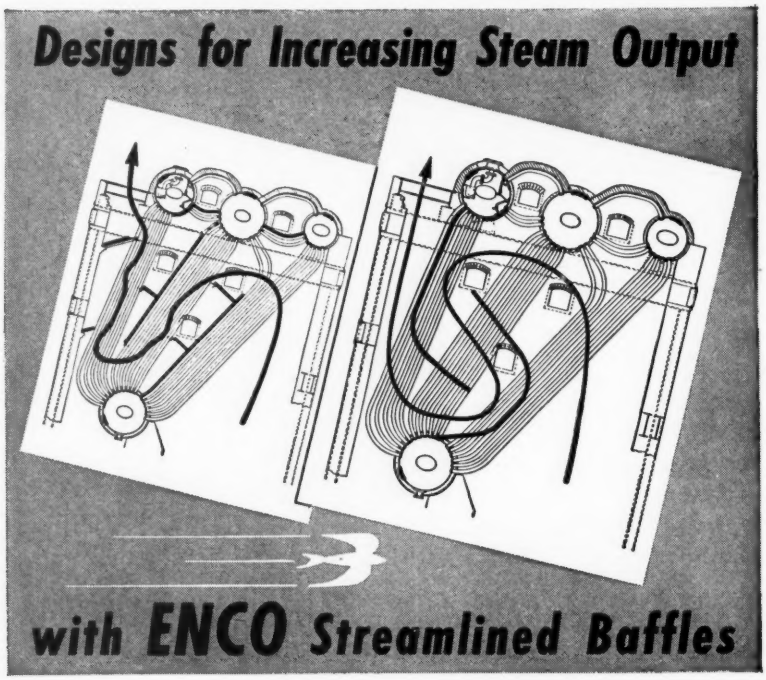
64 Condensate Return System—Description of operation and possible savings accompanied by line diagram and description of how "Jet-Loop" works; typical installations pictured and described. Drawings and text shows proven results from experience of users. 2 page spread of drawings and table of dimensions; 16 pages. Cochrane Corp.

65 Low Pressure Evaporators—Description of L. P. evaporators; types of evaporator plants, listing of advantages of L. P. submerged tube evaporators. Line diagrams illustrate principles brought out in descriptions. Typical installations are considered and analyzed; 12 pages. Condenser Service and Engineering Co., Inc.

66 Power and Industrial Equipment—Bulletin Q-12; describes and illustrates company's equipment for power and industrial use—steam turbines, motors, generators, feedwater heaters, turbo-chargers, steam jet ejectors, centrifugal blowers. Exceptionally well illustrated; 20 pages. Elliott Co.

67 Heat Exchanger—This new bulletin describes the company's Twin G-Fin Section; Bulletin 1614; section characterized as universal heat exchanger. Bulletin tabulates 21 features and corresponding advantages, describes design and construction. Installation views shown, field reports included; 16 pages. The Griscom-Russell Co.

68 Evaporators—Bulletin 364 describes, illustrates evaporators for various capacities and pressures; contains sections of special interest to plant engineers and executives; includes explanation of functions of evaporators, benefits obtained



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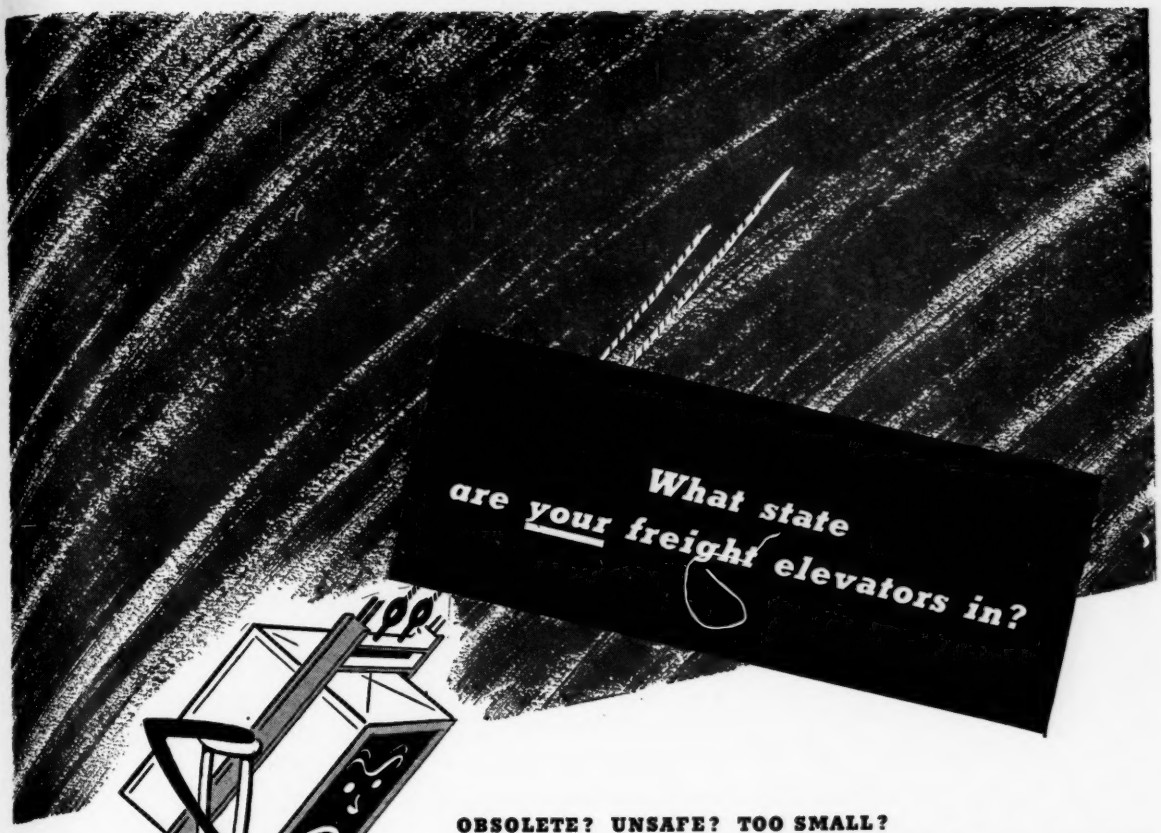

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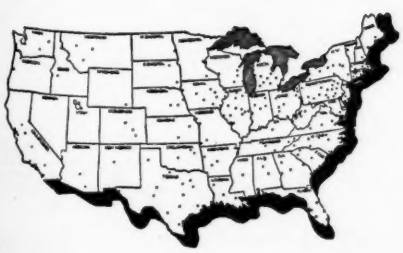

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by their use; different types of evaporator systems and their association with plant heat balance. 26 pages. The Griscom-Russell Co.

69 **Soot Blowers**—Bulletin F45; soot blowers in general are described. Description and operation of units, materials and specifications and other pertinent information is presented; tables of steam consumption, boiler efficiency, fuel saving chart; boiler cross-sections with blower locations indicated thereon and installation drawings and data are included; 10 pages. Marion Machine, Foundry & Supply Co.

70 **Water Heater Capacity Ratings**—14 tables are included in this ratings booklet showing capacity ratings per hour for temperature rises of from 20 deg (50 to 70 deg) up to and including ratings for a 150 F temperature rise (50 to 200 F). Table No. 15 presents the rate of flow of steam through pipes with steam from an initial gage pressure of one pound up to 150 psi. Marion Machine, Foundry and Supply Co.

71 **Air Ejectors**—Bulletin M-300 and M-301; what they do; types, blueprint type drawings, tables of sizes, manufacturing facilities and equipment; total 16 pages. The Lummus Co.

72 **Coal Weighing Scales**—Description; outstanding features, specifications, line drawings, photos; 4 pages. Beaumont Birch Co.

73 **Rack and Pinion Gates for Coal and Ashes**—Ball-Bearing, dust-tight features; photos, specifications, drawings, tables of dimensions; 4 pages. Beaumont Birch Co.

74 **Steam Specialties**—Collection of folders; steam trap, air trap, reducing valves, classes E, B and H pump governors, automatic boiler feedwater controller; parts and unit list prices; descriptions; illustrations; tables of capacities. The C. E. Squires Co.

75 **Deaeration**—Data book; No. N-15 gives reasons for and principles of deaeration; cold water deaeration; tabular drawing and chart material presented; well illustrated; 20 pages. Elliott Company.

76 **Power Plant, Industrial Process Equipment**—Steam turbines, turbine generators, mechanical drive turbines; motors and generators; feed-water heaters and deaerators; condensers and auxiliaries; steam jet ejectors; centrifugal blowers; turbochargers for diesels; accessories and tube cleaners; completely illustrated; 20 pages. Elliott Company.

77 **How to Choose a Steam Trap**—Trap selection, trap rating, trap capacity factors, individual trapping, determining lift; traps for unit heaters, pipe coils, fan system heating surfaces, steam jacketed kettles, autoclaves, laundry equipment, paper makers, etc.; installation, operation, maintenance, instructions; specifications and capacities; corrosive service; 42 pages. The V. D. Anderson Co.

WATER TREATMENT

78 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

79 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

80 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

81 **Water Conditioning Service**—"The 6 Fundamentals of Betz Water Conditioning Service" illustrates and describes how this company extends a supervisory service for boiler water conditioning. Booklet shows complete operation of these 6 steps; 16 pages. W. H. & L. D. Betz.

82 **Water Softeners**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

83 **Softener Handbook**—Manual, semi- and full-automatic zeolite water softeners are covered in Bulletin 315. Water softener plant is discussed in the first section and operating cycles and plant supervision is next considered. The third section is "Selecting Manual or Automatic Equipment"; this is accompanied by a table of comparison data. There also is a two-page section of tabular material and a zeolite nomographic chart. Graver Tank & Mfg. Co., Inc.

84 **Sludge Reactivator**—Illustrated booklet, 8 pages, fully explains the principle of upward sludge filtration and describes its adaptability to industrial and municipal water supplies. Charts, flow diagrams and cut-away drawings show clearly how equipment softens and clarifies raw water, materially reduces reaction time and provides, in many cases, a water that is suitable for process work without further treatment. Graver Tank & Mfg. Co., Inc.

85 **Hot Process Water Treatment**—Form 326 is a case study bulletin; covers results of an installation of the company's hot process equipment at Kankakee Ordnance Plant. System was designed to provide 60,000 gph of properly conditioned water, free from hardness, scale forming minerals and corrosive gases. Excellent photos and schematic diagram of installation with flow of water indicated. Graver Tank & Mfg. Co., Inc.

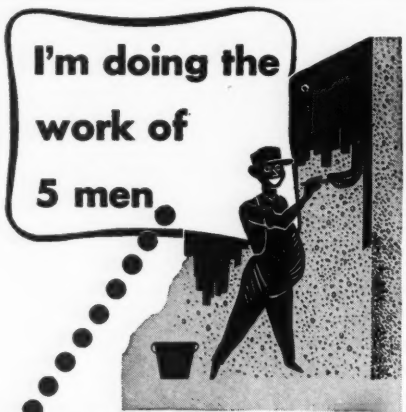
86 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Products, Inc.

87 **Industrial Water Treatment**—Micro-biological Control of and Through Industrial Waters; spot summaries of improvement of process efficiency and product quality by proper sterilization. Wallace & Tiernan Products, Inc.

88 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important considerations in chemical treatment of cooling water circuits. Wallace & Tiernan Products, Inc.

89 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Products, Inc.

90 **Clarifying and Softening Water**—Eight-page catalog "Reactivator for Clarifying and Softening Water by Upward Sludge Filtration." First part of the booklet tells how the reactivator works and how the sludge blanket is kept in control so as not to flow out with the clarified water. Line diagrams illustrate the principle of operation.



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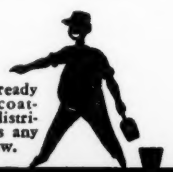

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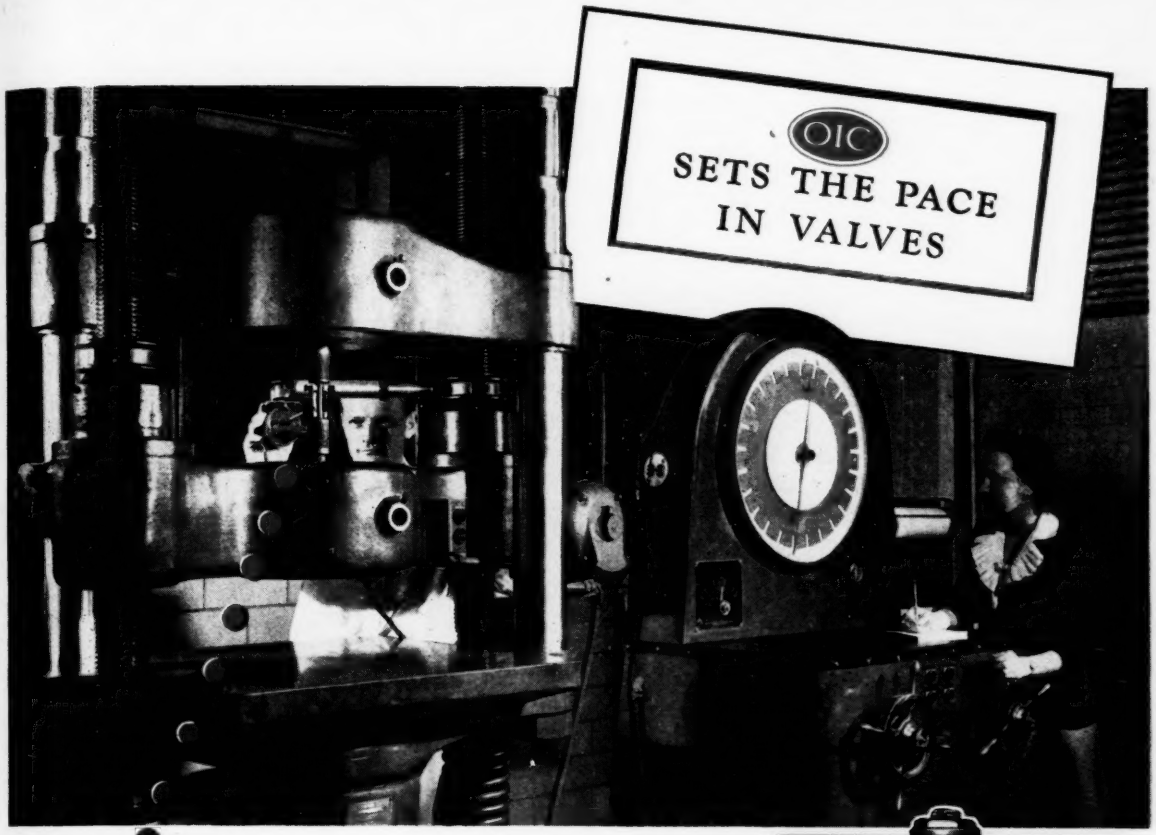

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Two pages are devoted to a sectional diagram through a reactivator and the accompanying copy tells about the unit's features. Actual installations are pictured and described. Graver Tank & Mfg. Co., Inc.

91 **Feed Water Treatment**—This four-page folder tells how the company's engineering applied to boiler feed water problems can result in savings. It tells of the different procedures and presents diagrams of equipment arrangement. Typical installations in dairy, cosmetic, aircraft, laundry, and other plants are pictured. Illinois Water Treatment Co.

92 **Chemical Feeding and Proportioning**—Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

93 **Automatic Proportioning**—Bulletin 1200, 28 pages. Handy reference book containing wealth of information on automatic flow responsive equipment and methods in continuous process operation. Photos of equipment and installations are supplemented by many flow diagrams and detail drawings. Complicated subject made exceptionally clear and understandable by careful arrangement and two-color diagrams. Proportioneers, Inc.

94 **Chemical Proportioning Equipment**—Bulletin 1714 covers chemical proportioning equipment for sea-going service. Two units—for high or low pressure—are described fully. Tabular material assists in the description. Proportioneers, Inc.

COATINGS, TREATMENT

95 **Protective Coatings**—4-page folder 844-246 describes Bitumastic Hi-Heat Gray, a specialized industrial protective coating which is said to resist corrosion and temperature up to 1200 F. The folder is in 2 colors and contains several photographs of equipment on which Bitumastic has been applied. It also gives a list of uses for the material and a chart giving its characteristics. The last page of the folder contains a brief description of four other types of Bitumastic coatings. Wailes Dove-Hermiston Corp.

96 **Fuel Oil Treatment**—A 4-page bulletin, telling about the company's treatment for fuel oil called "No Sludge." Advantages of using the treatment such as stepping up efficiency and reducing operating costs are explained. A list of dosages and applications are also given. A free test offer of the treatment is explained on the first page of the bulletin. Dominion Chemical Co., Inc.

97 **Flue Cleaner**—The company's soot and fire scale removing compound is described in this six-page folder. Results obtained from the use of this compound are described in the first part of the folder and then a list of the things which the company guarantees the material will accomplish are listed. Tables of dosage are presented and another table shows losses due to soot and fire scale. Dominion Chemical Co.

98 **Boiler Rust Treatment**—This four-page bulletin describes the company's "Rustoff" chemical which is said to "build resistance to rust- and scale corroded and congested pipes." The bulletin tells how the treatment works and what results may be expected from its use. A brief description of the campany's service department is included. Dominion Chemical Co., Inc.

HEATING, COOLING

99 **Cooling, Heating, Air Conditioning**—Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data; numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc.; 74 pages. Niagara Blower Co.

INSULATION

100 **Industrial Insulations**—Block, blanket insulations; pipe covering; new pressure coverings; insulating cement; felt; Koldboard; fill insulation; diatomaceous earth products; uses, specifications, applications, preparation; charts; photos; list prices; 26 pages. Baldwin-Hill Co.

101 **Insulating Cement**—Ease of application; efficiency; ease of maintenance; application recommendations; heat loss calculations; 4 pages. Baldwin-Hill Co.

STOKERS

102 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 tables. American Engineering Co.

103 **Water-Cooled Stoker**—Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

104 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

105 **Pneumatic Spreader Stoker**—Three-fold booklet on the inner pages of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

106 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

107 **Coal Reference Bulletin**—Bulletin 8, Underfeed Stoker Firing. Bulletin covers factors involved in selection of multiple retort stokers, principles, design data and drawings of typical installations; 6 pages. Fairmont Coal Bureau.

OIL, GAS BURNERS

108 **Stoker Firing Operation**—Single Retort Underfeed Stoker Firing is the subject of Bulletin Number 9 issued by this Bureau. It is a complete analysis of the advantages of the single retort stoker in the smaller plants. Types of this stoker are described and principles of operation are outlined. Selection of coal and the application and engineered installation of the stokers are considered at length. A maximum burning rate guide is included. Fairmont Coal Bureau.

109 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control; drawings; 4 pages. Peabody Engineering Corp.

110 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

(Continued on page 164)

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ENGINEERS' PREVIEW

A COMPLETE SUBJECT INDEX of technical articles appearing in the *Philips Technical Review* between January 1936 and June 1942 is now available from Philips Lamp and Radio Works, Eindhoven, Holland, or through the Elsevier Book Co., Inc., 215 Fourth Avenue, New York 3, New York.

★ ★ ★

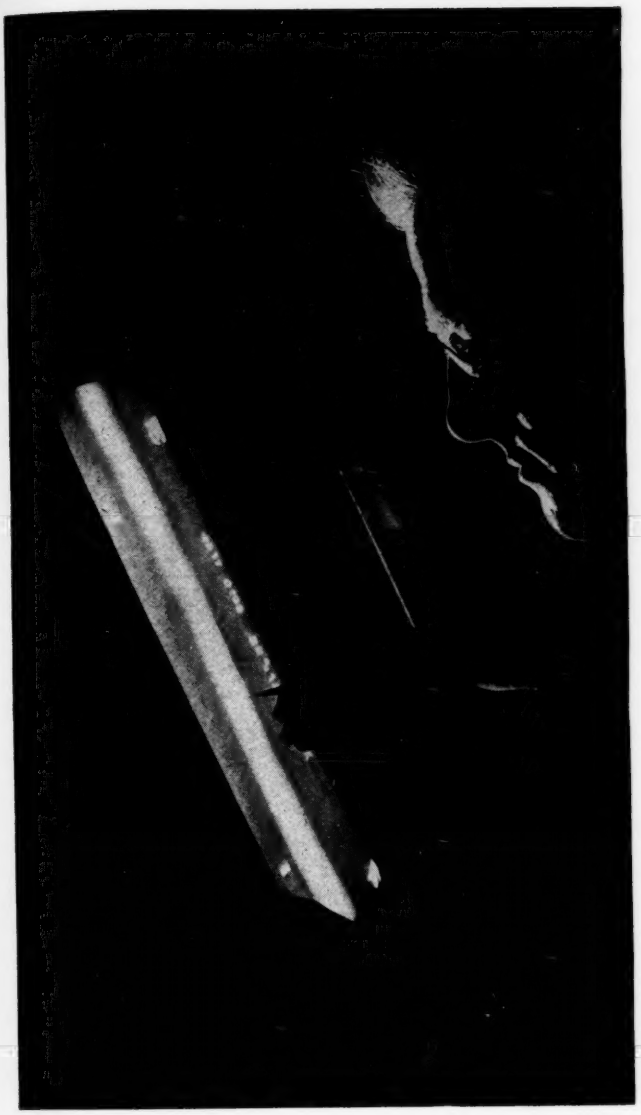
THE DIFFICULT PROBLEM of what to do about the atom cannot be solved by merely wishing that the secret of nuclear energy had never been discovered. "These phenomena are part of nature," says Dr. Robert Fox Bacher. "The discovery was as inevitable as that of fire. It may be that the world is confronted with a nasty problem—but that is the way life is. You can't spend your time looking backward. This is a real challenge, and we are going to get at it as quickly as we can." Dr. Bacher is the nuclear physicist recently appointed to the five-man Atomic Energy Commission.

★ ★ ★

NEW RUBBER Hyde-Ro ring for packing cast-iron water and sewer pipes is offered as an eliminator of bacteria in such joints since rubber cannot support bacterial growths. This permits sterilizing agents to do their work, eliminates re-contamination. Replaces standard joint packing on ball and spigot pipe, fits without measurement or cutting, no laps, effective in repairs since rubber ring dams off water from leaking valves. Cost is insignificant compared with repeated treatment costs.

★ ★ ★

FOR THE FIRST time in history, so far as anybody knows, man has made snow from a natural cloud in the sky. It all began when Vincent Schaefer of the GE Research Laboratory began experimenting with pellets of dry ice to "seed" a laboratory cloud of sub-cooled water droplets and form ice particles close to the surface of the dry ice. A little later, flying in a plane, Schaefer dispensed six pounds of small dry ice pellets over a cloud about three miles long. Within two minutes a radical change in the cloud took place and streamers of snow began to pour out of the base of the cloud. In these tests the snow did not fall all the way to the ground because the air and the ground surface were too warm. But the fact that it actually did fall from the cloud was proved, we understand, by flying underneath it. The snow produced was true snow in crystal form exactly the same as that of any naturally-falling snow. Whether this will lead to rain making, nobody knows at the present moment. But if it should, the possibilities are, at the very least, fantastic. General Electric Co. has had dozens of requests from skiing resorts, including the famous St. Moritz, to send somebody to consult about making snow. One request comes from a place in Chile, where many clouds pass over the mountains and out to sea without dropping snow or rain. Arrangements for further testing of the process are being made in co-operation with the Evans Signal Corps Laboratory at Camp Evans, N.J.



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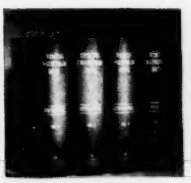

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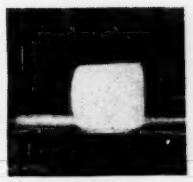

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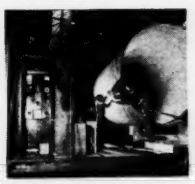
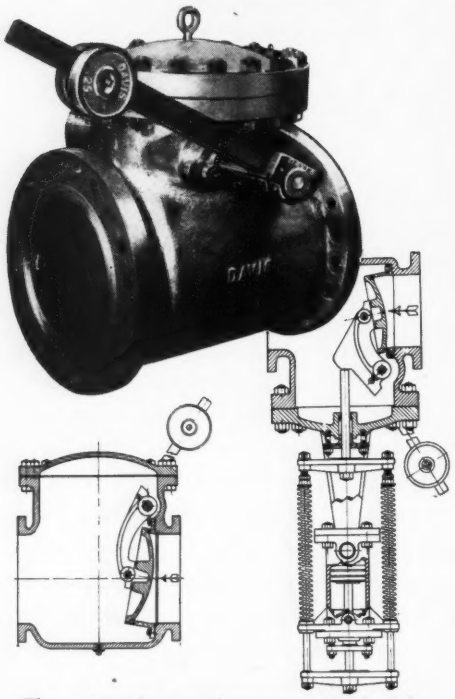


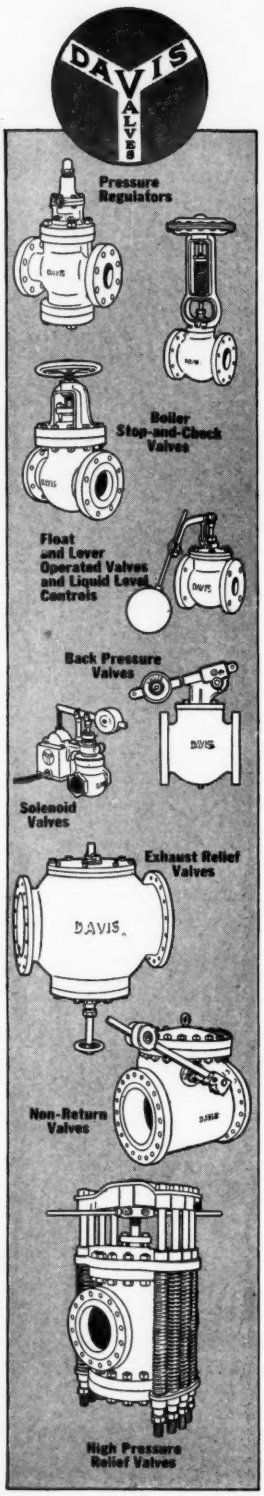
Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

Top Welding Performance assured by specially designed equipment . . . exclusive employment of master operators.

TURBINE BLEEDER LINE NON-RETURN VALVES





The outstanding performance record of the Davis "*Straight Flow Type*" Non-Return Valve in modern power plant service is the direct result of:

1. **Advanced Design**
2. **Quality Construction**
3. **Davis Service Recommendations**

The counterbalanced swing check design illustrated here is widely favored because of its simplicity . . . visible action . . . straight line flow . . . full pipe size port area . . . very slight resistance to flow . . . sensitive operation . . . and easy accessibility of internal parts. Depending on service requirements, it can be furnished with outside oil dash pot for cushioning action. For turbine bleeder line service, a spring-loaded oil control cylinder can be added (as shown above) for quick, positive closing on turbines equipped with automatic emergency (overspeed) steam shut-off hook-ups.

Check with Davis on your Non-Return Valve requirements. The Davis line is complete. Standard sizes from 4" to 24". For any pressure. Write for catalog and recommendations.

DAVIS REGULATOR CO.

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HELPFUL BULLETINS

(Continued from page 160)

111 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross-sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

OIL, LUBRICATION

112 **Lubrication Recommendations** — Special oils for diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

113 **Cutting Fluids**—Facts about cutting fluids; machine tool operations; fundamentals of cutting; how to apply; metallic cutting tools; tabular material; show practices; 50 pages. Standard Oil Company of California.

114 **Diesel Operation**—Relation of fuels and lubricants in the operating efficiency in the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

115 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

116 **Lubricants Service Handbook**—28 pages in this booklet on lubricants and their application. The development of the lubricant, its features and advantages and the manner in which it meets various operating conditions take up the fore part of the booklet. Two pages are used to cover definition of the various types of lubricants in the line, both fluid and grease type. "Application of Lubriplate Lubricants" is a useful section of the book; it shows and tells by sketch and description where the various lubricants should be used and why. The most useful part of the book is the "Recommendations" section where the manufacturer tells just what grease or oil should be used according to speeds, temperatures, pressures and general service conditions. Fiske Brothers Refining Co.

POWER TRANSMISSION

117 **Speed Reduction, Increase Gear**—Bulletin S-130; description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Troy Steam Turbine Co.

118 **V-Belt Drive Guide**—Bulletin B6051F; guide to company's complete line of V-belt drives. Contents include types and sizes, V-belt prices, how to figure drives, belt selector charts and tables and similar engineering information. Well illustrated; 12 pages. Allis-Chalmers Mfg. Co.

119 **Chains and Sprockets**—Bulletin D-1; 2 color digest catalog, profusely illustrated, gives pertinent information on drive and conveying chains and sprockets, finished steel roller chains and sprockets, silent chains and sprockets, flexible couplings. Tables of numbers and pitches are given as are full page tables of last prices, dimensions and weights; 16 pages. Union Chain & Mfg. Co.

120 **Flexible Couplings**—Bulletin 57; 2 pages of drawings and tables of ratings for company's flexible couplings. Installations are shown and features of the various types are discussed; 20 pages. John Waldron Corp.

VALVES

121 **Regulating Valves**—Bulletin 1-A; valve data book, description, dimensions and lists of parts; typical installations, rated capacities; prices; 52 pages. Atlas Valve Co.

122 **Pressure Regulator**—Bulletin 1-B; description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

123 **Pressure Reducing Valves**—Bulletin 1-C; sectional drawings, list prices, dimensions and weights; operation and adjustment; capacities for steam and air; 12 pages. Atlas Valve Co.

124 **Corrosion Resistant Valves**—Two bulletins, both of them on corrosion resistant valves have just been issued. One of them, a technical information bulletin covers the mechanical properties, analysis range, applications, advantages and sizes and specifications of the valves. The other is devoted to a photographic display of the installation of the valves. Alloy Steel Products Co.

125 **General Service Valves**—Bulletin E-150; valves for blow-off; fire protection, soot blower lines, acids, process etc.; descriptions; exploded views; features; dimensions weights and

R/M PLASTIC PACKINGS

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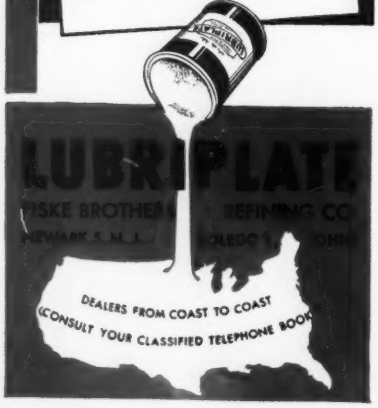

list price tables; parts and parts list; 14 pages. Everlasting Valve Co.

126 **Valves**—Bulletin E-100; for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

127 **Multiport Relief Valve**—Bulletin 4150; complete description of valves and operating characteristics, photographs of typical installations. Engineering data includes sizing information tables, nomenclature, installation and operation. list prices of accessories, dimensioned drawings and tables of dimensions; 28 pages. Cochrane Corp.

128 **Steel Valves**—Bulletin 102; 4 page bulletin describing company's "Evrtyte" valves. Cross-sectional illustrations and tables of seat orifice sizes, prices and dimensions are given; listing of features, description of the operation of the unit and parts and prices for assemblies Strong, Carlisle & Hammond Co.

MAINTENANCE

129 **Valve Data Book**—Engineering, operating and maintenance data on pressure reducing, differential and overflow valves are contained in Bulletin 461 issued recently; it is a 20 page issue. Large, cross-sectional and external views of each class of regulator are shown together with construction details, exclusive features and complete tables of pressure ranges, sizes and capacities. A handy "ready-reference" index chart at the front of the bulletin simplifies selection of the best valve for any specific industrial application including steam supply to air ejectors, dye tanks, etc. Recommended installations are shown and discussed for remotely adjusted valves, valves with internal parts and valves designed for external control. Approved methods of grinding main valves, tightening controlling valve seats and checking control valve stem clearance are described pictorially. Dismantling, cleaning and assembling information given. Leslie Co.

130 **71 Maintenance Jobs**—This guide tells how better to perform commonly occurring power plant maintenance and cleaning operations. Illustrated manual gives specific material and method recommendations for handling cleaning, degreasing, descaling, derusting, paint stripping, etc. Booklet is completely indexed and reference is made easy by colored type strips on edge of the pages; 22 pages. Oakite Products, Inc.

131 **Maintenance, Repair Tools**—Company's line of pneumatic drills, screw drivers, file and die grinders, riveting hammer and pneumatic tool accessories. Other tools include metal etchers, chucks, portable demagnetizers and many others. Completely illustrated; 24 pages. Ideal Industries, Inc.

132 **Protecting Metal**—High heat resistant coatings for protecting metal surfaces in power and processing equipment are covered in 4 page bulletin. Brief description of properties of coatings are given. The Dampney Co. of America.

133 **Condenser Tube Inserts**—Description of Flowrites; illustrated, accompanied by report of tests on Flowrites made by M.I.T. Tables and charts of test results are presented; description of how to install inserts given; 8 pages. Condenser Service & Engineering Co., Inc.

CONTROLS, METERS

134 **Damper Regulators**—Bulletin 4-A; for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adjustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

135 **Thermostats and Relays**—Bulletin T, a 12-pg. catalog presents significant information on this company's mercurial thermostats and adjustable thermoregulators. Also included is complete data on relays, designed as companion instruments to the above mentioned. Complete descriptions of the instruments are included and the bulletin is well illustrated. Precision Thermometer & Instrument Co.

136 **Recording Flow Meter**—Bulletin 349; what it does, features, chart of rated capacity; construction and operation; installation drawings, tables of capacity; photos; 8 pages. Builders-Providence, Inc.

137 **Propeller-Type Meter**—Bulletin 350A; for main-line metering; applications, description, installation, materials of construction; features; table of capacity, shipping weights; specifications, drawings; 4 pages. Builders-Providence, Inc.

138 **Centralized Combustion Control**—Bulletin 43-605; applications to various types of fuels and burning equipment; controller, measuring elements, pilot device, power unit, etc.; 24 pages. The Hays Corp.

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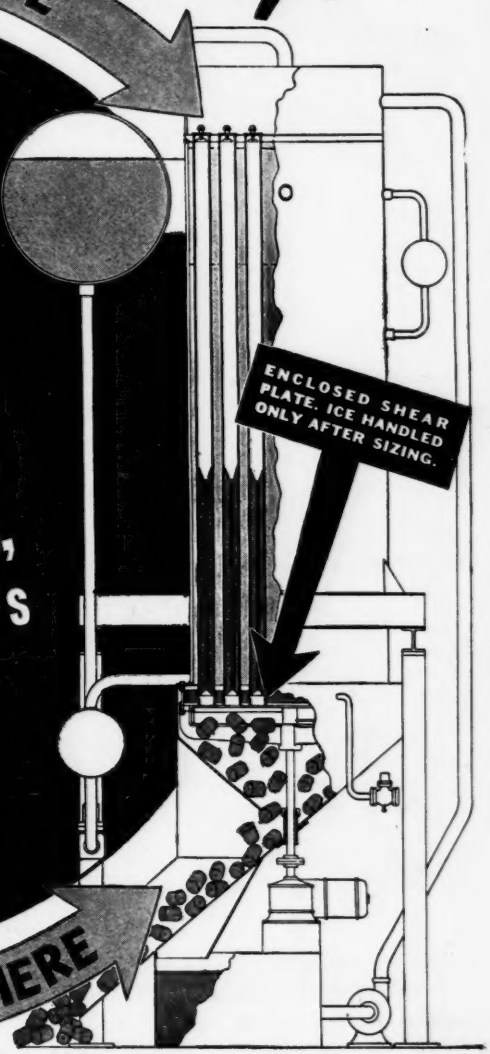

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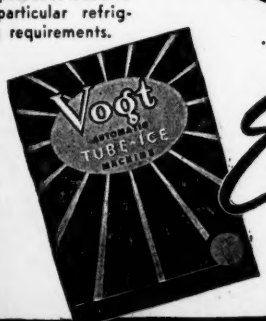

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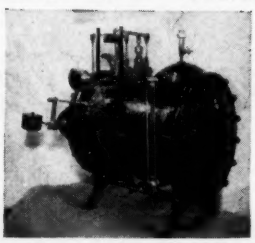

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139 **Combustion Meters**—Bulletin 44-550; reasons why it is; accurate, dependable, simple, rugged, easy to install, easy to maintain, speedy, easy to understand; well illustrated by explanatory diagrams; 16 pages. The Hays Corp.

140 **Feedwater Textbook**—"Mechanical Feedwater Regulation for Boilers" by Prof. E. P. Culver; principles of feedwater regulation; mechanical equipment available; differential pressure control; feed pump control; illustrations, diagrams, charts; 36 pages. Northern Equipment Co.

141 **Engineering Monographs**—Series of eight on automatic combustion control; 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Travelling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

142 **Draft Gages**—Bulletin 46-667; gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; descriptions of equipment; differential units, Bourdon tube units, pointer gages, etc; 20 pages. The Hays Corp.

143 **Draft**—Bulletin 46-472; what draft is; where it is found; how it is measured; what the draft gage tells, where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

144 **Flue Gas Analyzer**—Bulletin 45-668; principle of operation; construction features; technique; models and prices; Burrettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

145 **Indicating, Control Systems**—What they are, what they can do; Bulletin 14B6641. Description of how transmitter, receiver and indicator of systems are constructed, how they work, their advantages and specifications. Illustrated with photographs, diagrams, charts; 12 pages. Allis-Chalmers Mfg. Co.

146 **Water Gages**—Condensed catalog, Bulletin E, of company's complete line of water gages. Each model illustrated and accompanying table gives sizing information; 8 pages. Ernst Water Column & Gage Co.

147 **Stainless Steel Bellows**—Bulletin SSB-46; contains diagrammatic cross-section views and up-to-date information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors, for flow control, vapor and steam traps, thermostatic instruments, etc. Completely illustrated; 12 pages. Chicago Metal Hose Corp.

148 **Pitot Equipment**—Three section Bulletin 50; gives complete details of the use of Pitot tubes and rods, instructions in the use of the company's portable Pitot recorder, together with theory, formulae, notations and curves. Completely indexed; 20 pages. Simplex Valve & Meter Co.

149 **Manometers**—Bulletin 200; describes completely this line of fixed and portable manometers for use in water surveys and similar flow rate measurement, valuable engineering data also included. Illustrations include line drawings and photographs; 8 pages. Simplex Valve & Meter Co.

150 **Instruments, Controls for Process**—Bulletin 17; process controllers, control components, measuring components and instrument combinations briefly described and illustrated. Application data such as sizes, pressure standards and ranges are listed; 8 pages. Bailey Meter Co.

151 **Temperature Regulators**—Bulletin 7-A; six types; descriptions, list prices, tabular material, photos; list of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

152 **Draft, Excess Air and CO_2**—Bulletin 39-341; discussion of the relation of these elements to the installation and servicing of bituminous and anthracite stokers by Arnold Soller; 12 pages. The Hays Corp.

PACKING, GASKETS

153 **Packing**—Bulletin 237; photos and descriptions of use; installation drawings; standard size table; 4 pages. Warren Steam Pump Co., Inc.

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154 **Standards for Flanged Fittings, Valves, Flanges**—Pressure temperature ratings, tables and charts, rating procedure, flange materials, safety factors, loading, stress formulas; 20 pages. Tube Turns, Inc.

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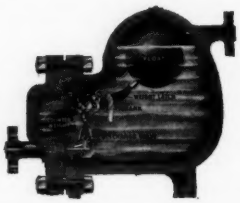

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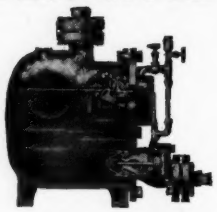

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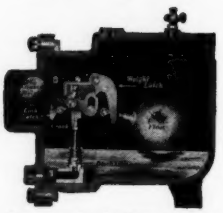

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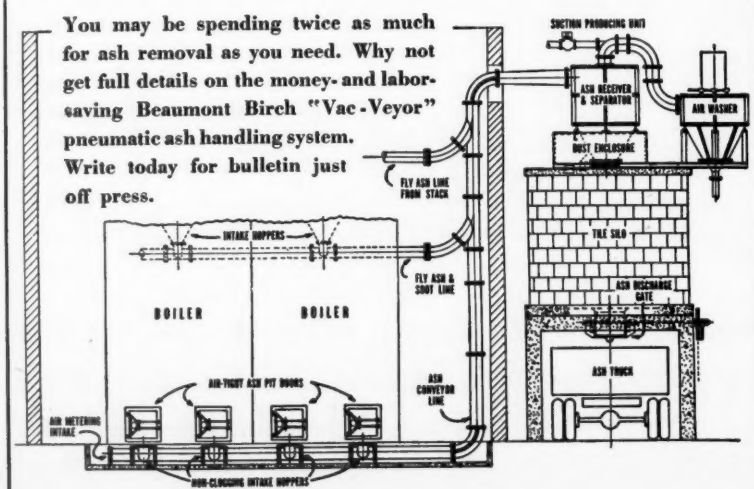

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157 **Unions**—Complete line of malleable iron unions and convenience unions; illustrations, descriptions, size and list prices; descriptions of materials and workmanship; 24 pages. Jefferson Union Co.

PUMPS

158 **Horizontal Duplex Piston Pumps**—Bulletin 230-1; specifications, steam end, liquid end; capacity tables for pressure service, light pressure service; dimensions, drawing, tables; 4 pages. Warren Steam Pump Co., Inc.

159 **Steam Heat Vacuum Pumps**—Bulletin 226-1; specifications, drawings, general information, tables of sizes and capacities; 4 pages. Warren Steam Pump Co., Inc.

160 **Centrifugal Pumps**—Bulletin 302-30, Revised; instructions for installation and operation; drawings, tabular material; 12 pages. Warren Steam Pump Co., Inc.

161 **Hydraulic Pressure Pumps**—Bulletin 238; specifications, sectional photos, important features; full page table of capacity, sizes, pipe sizes, pressure; 4 pages. Warren Steam Pump Co., Inc.

162 **Screw Pumps**—Recommended uses; advantages; tables of capacities and sizes; charts of test results; dimensioned drawings; suctions and discharge, packing box sizes, shipping weights tables; specifications; installation and maintenance; theoretical horsepowers; viscosity classifications; 18 pages. Sier-Bath Gear & Pump Co., Inc.

163 **Centrifugal Pumps**—Booklet describes basic action of centrifugal pumps, tells of the science of centrifugal action and the physics of pumping. Performance curves are presented. Descriptions of the company's self-priming centrifugal pumps are given and how they operate is explained. Typical uses of the units are pointed out and installation and operation explained; 20 pages. Marlow Pumps.

MISCELLANEOUS

164 **Floor Resurfacing**—This recently-published folder describes the methods of use of the company's heavy-duty resurfacer for use on floors, traffic aisles and loading platforms. It contains a concise, clear description of the properties, methods of application and advantages of the resurfacer and is of interest to everyone who has problems in the maintenance and repair of concrete floors. Stonhard Company.

165 **Electric Tools**—Bulletin 464; covers complete line of portable electric tools for construction and briefly describes such tools as electric hammers, drills, chisels, vibrating tools, accessories, screw drivers, etc. Prices are given. Syntron Co.

166 **Refractory Concrete**—"Lumnite for Refractory Concrete"; basic information on materials and methods used in making refractory concrete. Illustrations show application of concrete in construction of furnaces, coke ovens, etc. Another section covers concrete use in foundations, floors and structures subject to high heat; 24 pages. Lumnite Division, Universal Atlas Coincut Co.

167 **Gas Purger for Refrigeration System**—Bulletin 160; tells how to cut power costs and raise condenser capacity by proper purging of non-condensible gases. Tables of ammonia properties, advantages and complete illustrated material. Typical installations are pictured. Two pages with diagrams tell how purger operates; 8 pages. Armstrong Machine Works.

168 **Grinding Wheels**—Grinding wheels of various abrasives are illustrated and list prices presented; tables of sizes in inches are accompanied by photographs and line drawings of these various wheels. Grinding wheel dressers with list prices are shown; 32 pages. Norton Co.

169 **Weldments**—Bulletin SP106 tells about the services of this company's weldry and the weldments turned out therein. The products of this weldry are shown and the text points out how flexible the method is by showing that it makes no difference if the finished product is constructed of light sheet or heavy metal . . . the resulting product can be made to exacting specifications. Graver Tank & Mfg. Co., Inc.

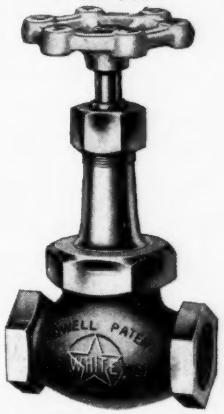
170 **Drop Forged Flanges**—Manufacturing processes; physical characteristics; full-page tables of illustrations, dimensions, weights and prices. Space provided for future insertions. Phoenix Mfg. Co.

For assured flow control, the valve must suit the service

You don't have to be an Isaac Walton to know what's wrong with these fishing pictures. Silly misapplications of equipment, aren't they? But no sillier than using *valves* in services for which they were not specifically designed.

Through more than a hundred years of making valves—and valves only—Powell Engineers have been designing the *right* valves to suit the specific requirements of every existing industrial flow control service. Today, the Powell Line includes Bronze, Iron and Steel Valves of every necessary type, design, size and pressure. And, for corrosion resistance, Powell makes a notably complete line in the widest range of pure metals and special alloys ever used in making valves.

That's why, *for assured performance,* it pays to consult Powell.



Small size 200-pound Bronze Globe Valve for steam, oil, water or gas. For assured, long-life performance it has a renewable, specially heat treated stainless steel seat and a regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc.

Class 900-pound, 14", Cast Steel Non-return Globe Valve with welding ends. Has new pressure seal bonnet. Compound spur gearing provides easy operation. A Powell design to meet the demand for valves to handle higher pressures and temperatures.

Powell Cast Steel Valves of all types are made in pressure classes from 150 to 2500 pounds, inclusive.

The Wm. Powell Co.
Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

(Continued from Page 152)

from the War Assets Administration, it was announced recently.

The second Lowell plant to be acquired by the department within six months, the new Marginal Street plant, formerly occupied by the U. S. Rubber Co., will be used for the manufacture of building wire and other electrical construction materials.

Production is scheduled to begin within 30 to 60 days, when the necessary manpower and raw materials have been secured. Employment is expected to exceed 600 persons.

The plant will be under the direction of S. T. Powell, manager of manufacturing of the G-E Wire and Cable Division with headquarters at Bridgeport, Conn.

RAYBESTOS-MANHATTAN OPENS OFFICE IN CLEVELAND

OPENING of a consolidated office in Cleveland at 1071 Union Commerce Building, Zone 14 has been announced by Raybestos-Manhattan, Inc., to provide better representation and service in that territory. Other Cleveland Divisional offices have also been combined in this office.

Divisions of the Corporation are represented at this office as follows: Manhattan Rubber Division by T. Robinson; Asbestos Textile & Packing Division by D. E. Gow, and Equipment Sales Division for Raybestos-Manhattan, Inc. and the United States Asbestos Division, by E. E. Juergens. R. F. Tobin is office manager.

HERBSTER PRESIDENT OF NEFF & FRY

AT A RECENT meeting of the directors of The Neff & Fry Co., Camden, Ohio, builders of industrial storage bins and systems, D. H. Herbster was elected President, succeeding C. Rodney Neff.

Mr. Neff resigned the Presidency to devote a greater share of his time to outside interests and to the affairs of his father, the late Charles Neff, co-founder of the company. Rodney Neff will still serve on the Board, and he also assumes the duties of Treasurer formerly held by his father.

For the past 10 years, Mr. Herbster, the new President, served as Sales Manager, playing a most important role in the growth enjoyed by the company during this period.

NORDBERG ACQUIRES BUSCH-SULZER DIESEL

NORDBERG Manufacturing Co., Milwaukee, and Busch-Sulzer Bros.-Diesel Engine Co., St. Louis have announced that Nordberg has acquired certain manufacturing assets from the Busch-Sulzer, and proposes to continue its Diesel engine business as a division of the Nordberg Mfg. Co.

POWER FROM BURNING COAL MINE

SOME DAY, perhaps in the not-too distant future, removing coal from the mine, transporting it long distances by locomotives which are burning coal and then converting it into useful energy at the point of consumption may be considered as outmoded and wasteful as the old water wheel in the box factory down by the creek.

The possibilities uncovered in the latest experiments in burning coal right in the mine could easily revolutionize our present coal-burning economy. It is, of course, too early to tell how efficient the entire cycle may prove to be but it affords grounds for interesting speculation. Its effect on the economic structure could be enormous.

The Russian system of gasification was mentioned briefly in the January issue of POWER PLANT ENGINEERING, page 79.

In this country, too, a gas which could be used in manufacturing synthetic liquid fuels has been produced successfully by setting fire to one section of an underground coal mine, Dr. R. R. Sayers, Director of the Bureau of Mines, announced recently. The revolutionary experiment is being conducted by the Bureau and the Alabama Power Co. at the Gorgas mine near Jasper, Ala. No difficulty has been encountered in maintaining combustion, Dr. Sayers said.

Long interested in the practical possibilities of producing gas by burning unmined coal, Bureau officials stated that underground gasification may permit the use of impure coal and seams too thin to mine. It would also result in a more complete recovery. Today, coal mines leave an average of 35 to 50 per cent of coal in the ground.

Potential uses for the gas are many. It not only offers a new source of raw material for the manufacture of synthetic liquid fuels, including gasoline and lubricating oil, but a heating gas for burning under boilers in industrial plants. The gas may also prove a possible substitute for water power. In dry areas throughout the Rocky Mountain region and the West, electric power might be produced by using the gas in gas turbines.

Experimental work in underground gasification commenced in January at the Alabama Power Co.'s Gorgas mine. The company was interested in the practical application of piping gas from a burning coal seam directly to the boilers of a nearby plant for use in place of coal to produce electricity.

Isolating a coal bed from an active part of the mine, two horizontal entries six feet in width were dug into a 2½-ft coal seam and connected by a crosscut. Concrete pipings were installed at both ends of the two entries of the U-shaped structure. Several holes were core-drilled from the surface into the coal seam to take gas samples and temperature readings. To start the combustion process, incendiary bombs were dropped down several of these holes. Using a compressor, air was blown into one entry as gas emerged from the other. Air may be coursed through the tunnel from either direction.

Steady combustion was maintained and most mechanical difficulties were eliminated during the first 16 days of the experiment. However, the resistance resulting from the roof falls and other undetermined causes prevented an air flow sufficient to obtain the desired temperature in the burning coal and the quality sought in the gas. Therefore, a limited amount of oxygen was introduced to enrich the air, indicating the possibility of the continuous production of synthesis gas.

After the supply of oxygen was exhausted, an air blast was coursed through the tunnel, which resulted in a steady improvement in operating conditions and gas quality. A relatively high-grade synthesis gas also was produced by alternately blowing air and steam into the burning mine. This method is similar to an underground gasification system employed in Russia, which also utilizes alternate periods of air blasting and steaming.

Roof falls which occurred are believed to be as anticipated, according to Bureau officials. However, to study what has actually taken place in the earth during the experiment, strata overlying the burned area will be removed by bulldozers and shovels for analysis. The burned area will be steamed for several days and then flooded with water before extracting the stratified rock above the coal.

Considerable time was spent in making adjustments to equipment and apparatus in the first few weeks of the experiment. Further extensive research is required to determine definitely the technical and economic practicability of producing and using gas from a burning coal mine.

PRESIDENT'S FIRE PREVENTION CONFERENCE

FACED with an average annual toll of 10,000 deaths from fire, together with property loss which exceeded $560,000,000 in 1946, President Truman is sponsoring a nation-wide effort to cope with the fire menace.

The President's Conference on Fire Prevention is now past the formative stage and a volunteer staff is at work preparing for the meeting, which will be held May 6-8 in the Departmental Auditorium in Washington.

Representatives of muncipal and State governments, Federal agencies, and of non-official organizations with a basic interest in fire prevention have been organized into a coordinating committee to draft agenda for the Conference and to appoint committees which will prepare recommendations to be submitted to the Conference as a whole.

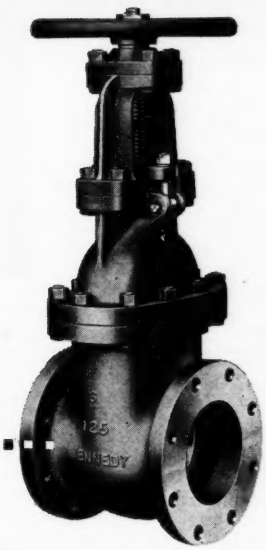
MANZEL BUYS PART OF BUSINESS OF BOWSER

DISCONTINUANCE of the manufacture of its force feed lubricators and the sale of its repair parts business on both Bowser and Torrington models to Manzel Brothers Co. of Buffalo, N.Y., has been announced by Bowser, Inc., of Fort Wayne, Ind.

CORNING GLASS ANNOUNCES CHANGES

IMPORTANT executive changes in Corning Glass Works were announced recently. Eugene W. Ritter, Vice President and Manager of Corning's Consumer Products Division, will become President of Corning Glass Works of South America. Succeeding Mr. Ritter as Consumer Products' Manager is Benjamin S. Peirson, who was formerly the division's General Sales Manager. Robert S. Beattie, Assistant General Sales Manager, will take over the post vacated by Mr. Peirson.

Arthur W. Weber, Manufacturing Manager of Consumer Products Division and Acting Manager of the division's Pressware Plant at Corning, will be relieved of the latter duties to devote full time to the expanding manufacturing operations of the entire division. D. Kenneth Shaddock, Manager of Corning's Plant at Central Falls, Rhode Island, will become



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to get **durability** on the **inside**

Kennedy Valves are durable. Look at this iron-body gate valve . . . note the stout construction of the disc . . . the exceptionally thick and wide disc and seat rings . . . the heavily proportioned stem threads.

You get these and many other features when you specify Kennedy Valves. Want full details? . . . write for a copy of Kennedy's 240-page Catalog. It contains complete information on the Kennedy bronze and iron-body gate, globe, angle and check valves, pipe fittings, flanges, and other valves and accessories.

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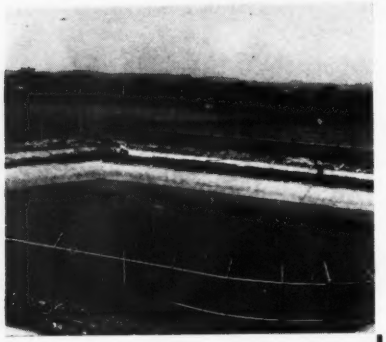
KV-148

The Kennedy Iron-body Wedge Gate Valve is made for a range of pressures with non-rising stem or outside-screw-and-yoke. Illustration shows standard type, outside-screw-and-yoke.

KENNEDY valves-pipe fittings-fire hydrants

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK *Offices and Warehouses in Principal Cities*



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Manager of Pressware, while James L. Knapp, Production Superintendent of Central Falls, has been appointed Manager of that plant.

FERGUSON COMPLETES NEW G.E. PLANT

THE H. K. FERGUSON Co., industrial engineers and builders, has announced the completion of a new manufacturing plant at Mattoon, Ill., for the General Electric Co. The plant is being used for the production of electric lamps. It is a one story structure containing approximately 120,000 sq ft of floor space and office facilities.

C. OF C. AWARD TO LEEDS & NORTHRUP

LEEDS & NORTHRUP Co. recently was given the first annual Industrial Relations Award of the Chamber of Commerce and Board of Trade at a dinner at the Bellevue-Stratford.

The award, a silver plaque, was made by William L. Batt, president of SKF Industries, to Charles S. Redding, president of Leeds & Northrup.

CLEVELAND CHAIN BUYS WOODHOUSE

PURCHASE of the Woodhouse Chain Works, Trenton, N.J., by the Cleveland Chain & Manufacturing Co., Cleveland, was announced today by David J. Gemmell, vice president in charge of sales of the latter concern.

The Trenton plant will continue in full operation as the Woodhouse Chain Works Division of the Cleveland Chain & Manufacturing Co. E. S. Washburn, present plant manager, will remain in the same capacity under the new setup.

WILLIAMS ELEVATED BY WORTHINGTON

THE BOARD of Directors of Worthington Pump and Machinery Corp., at its meeting of January 15, 1947, elected S. Riley Williams, Vice President in Charge of Foreign Business.

Mr. Williams joined the Worthington organization in 1920, immediately following his release from the United States Army, where he served as a First Lieutenant in World War I. From 1920 until 1941 he resided in Europe, where he was successively Managing Director of the Worthington Associated Co. in Spain, of its Associated Co. in France, and General European Manager. In 1941 he returned to the United States, and during the recent war served as Assistant to the Vice President in Charge of Operations. In May, 1945 he was appointed Director of International Business.

In his new capacity he will have responsibility for the sale of Worthington products for export, as well as the administration of Worthington Associated Companies in South America and Europe. He will make his headquarters at the Worthington Home Office in Harrison, New Jersey.

NORTHERN EQUIPMENT PERSONNEL NEWS

WILLIAM L. HUNTER, formerly Chief Engineer, has been named General Manager for Northern Equipment Co., Erie, Pa. A graduate of the University of Tennessee who served with the artillery in France during World War I, he joined the company in 1926. He is a member of American Society of Mechanical Engineers.

Harold A. Schlieder, who has been with Northern Equipment Co. since 1936, succeeds Mr. Hunter as Chief Engineer. He graduated from Rensselaer Polytechnic Institute, where he was a member of Sigma Xi honorary fraternity. From 1938 to 1941 he was in charge of Copes activities in the Far East and has more

GOLDEN-ANDERSON
design and build
over 1500
types and sizes in

automatic
VALVES
for safe protection
on any high pressure
installation

In addition to more than 1500 standard types and sizes of manual or automatic steam and water service valves—GOLDEN-ANDERSON engineers design and build special valves to meet most any difficult high or low pressure service.

Write today for descriptive, technical catalog.

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STEP UP
Steam Pressure
And Lessen Tube Failure

SAND-BANUM

Removes and Prevents Boiler scale and corrosion regardless of water or operating conditions. Does not carry over with the steam.

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YOU GET

Peak Load Efficiency, fuel economy, longer equipment life, fewer shut-downs.

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"The Entirely Different Boiler and Engine Treatment"

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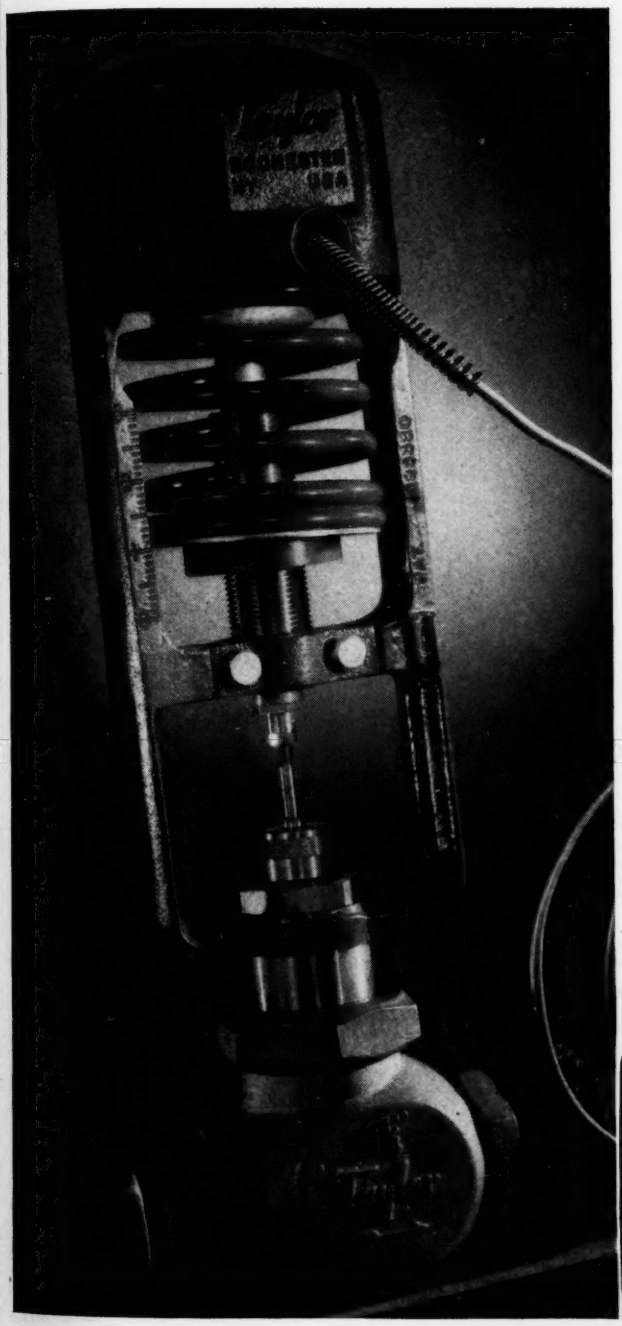
YOU NEED 'EM AND WE HAVE 'EM



SOMETIMES our customers ask for a Taylor Fulscope Air-Operated Controller for applications where a simple, dependable Taylor Self-Acting Controller would do the job.

Typical jobs which the Taylor Self-Acting Controllers take in stride are: hot water tanks, diesel water jackets, feed water systems, wax coating machines, plating and rinsing tanks, bottle and can washers, mixing and cooling kettles, crude oil treaters, condenser cooler water in stills, oil field superheaters, etc.

They require no auxiliary air supply for operation. Double seated valves are available in sizes up to 2″; single-seated composition disc types up to 1″. Numerous standard temperature ranges within limits of 10° and 340° F, and semi-standard ranges within limits of 165° and 610° F.

Immediate delivery now available! Write for catalog 36-R. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments . MEAN ACCURACY FIRST IN HOME AND INDUSTRY

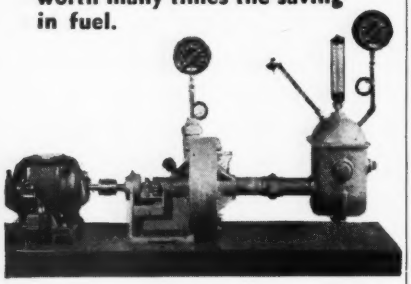
MORE PRODUCTION WITH LESS FUEL

That is the Unanimous Verdict of our Many Customers Using Process Steam.

Our Direct Return System collects condensate—ALL OF IT—at high pressure and temperature, and returns it to the boiler without traps. This saves fuel, usually 25% or more. Also saves water and water treatment materials—and the usual flash steam loss is eliminated.

Keeping jackets, coils, steam lines and drain lines free from water (no waiting for traps to fill up and dump) means that dry hot steam is available everywhere all the time.

You are thus assured hotter steam heated units, quicker heating up of cold units and a reduction in cooking or drying time (frequently 15% or more) and a corresponding INCREASE IN PRODUCTION, worth many times the saving in fuel.



This simple outfit is entirely self-contained. It comes all aligned and mounted on a metal base ready to be bolted down to a level foundation and started in operation. Capacity 10,000 lb. of condensate per hour under 20 lb. dynamic head. Other units up to 50,000 lb. of condensate per hour and up to 80 lb. dynamic head.

Write for descriptive bulletin and testimonials from many satisfied customers.

HEAT RECLAIMER CORPORATION

Engineers and Manufacturers
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Chicago 2, Ill.

recently been in charge of foreign engineering. He is a member of American Society of Mechanical Engineers, American Institute of Electrical Engineers and National Society of Professional Engineers.

Francis W. Bunting, who joined the company as a service engineer in 1935, has been appointed Assistant Chief Engineer. He is a graduate of Drexel Institute of Technology, and is a member of Pi Tau Sigma fraternity, American Society of Mechanical Engineers and National Society of Professional Engineers, serving as treasurer of the Erie chapter of the last-named organization.

REPUBLIC FLOW METERS APPOINTS TWO MANAGERS

REPUBLIC FLOW Meters Co., Chicago, has announced the appointments of two new district managers. Christian W. Marks will be manager of the Company's Cleveland District which includes Northern and Eastern Ohio, Western New York and Erie, Pa. The Company's office is located in Room 407, 830 Vincent Ave., Cleveland 14, Ohio.

Eugene N. Davidson has been appointed manager of the St. Louis District which includes Eastern half of Missouri, Southern half of Illinois and Western Kentucky. The Company's office is located at 912 Olive St., St. Louis 1, Mo.

CHIKSAN APPOINTED DISTRIBUTOR

THE APPOINTMENT of Chiksan Co., Berea, Calif., as exclusive distributors of the Okadee Loading Rack Valve has just been announced. In addition to covering the domestic market Chiksan Export Co. will also represent Chiksan, Well Equipment Manufacturing Corp. and the complete line of Okadee Valves for export.

B & W's REPLACEMENT PROGRAM

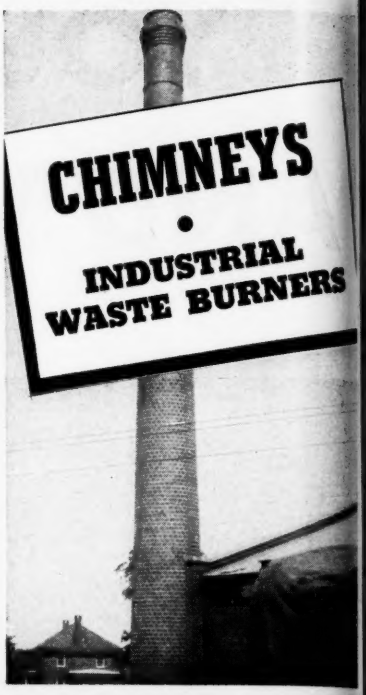
ANNOUNCEMENT of a two-year, $1,500,000 program for machinery replacement and improvement of its Barberton plant was made by The Babcock & Wilcox Co. recently. The money for this project, which will include all shops, has already been allocated. In addition to the new equipment to be installed, production will be facilitated by the relocation of machinery and rearrangement of certain shops in order to minimize the handling of both raw materials and the products manufactured.

The improvement plan will proceed without interrupting production. To date about one-half of the funds allotted have been spent. The program was drawn up by the Company's Staff Engineering Department in conclusion with the heads of shops and executives.

"All types of shop equipment and machine tools will be purchased," said George J. Hartnett, Jr., head of the Staff Engineering Department. "The expenditures are made not only to increase plant capacity, but to maintain and improve quality of products. In addition, the major rearrangement of processing machinery and the purchase of certain new equipment, such as dust collectors, will improve shop working conditions."

Ward Leonard Electric Co., Mount Vernon, N.Y., has announced the appointment of the Southern Sales Co., 1135 Lincoln Tower, Fort Wayne 2, Indiana, as its industrial representative in Indiana and western Kentucky. The Southern Sales Co., will also continue to represent the Ward Leonard Electric Co., in the Electronic Distributor Division.

Establishment at Kenosha of an International Division for export sales by the Snap-on Tools Corp. and the appoint-



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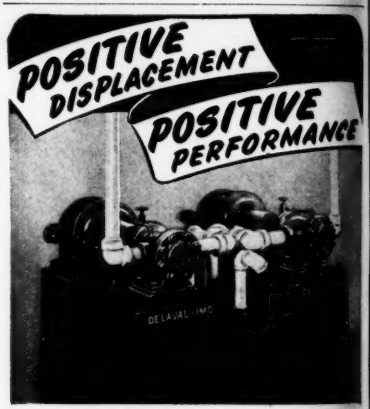


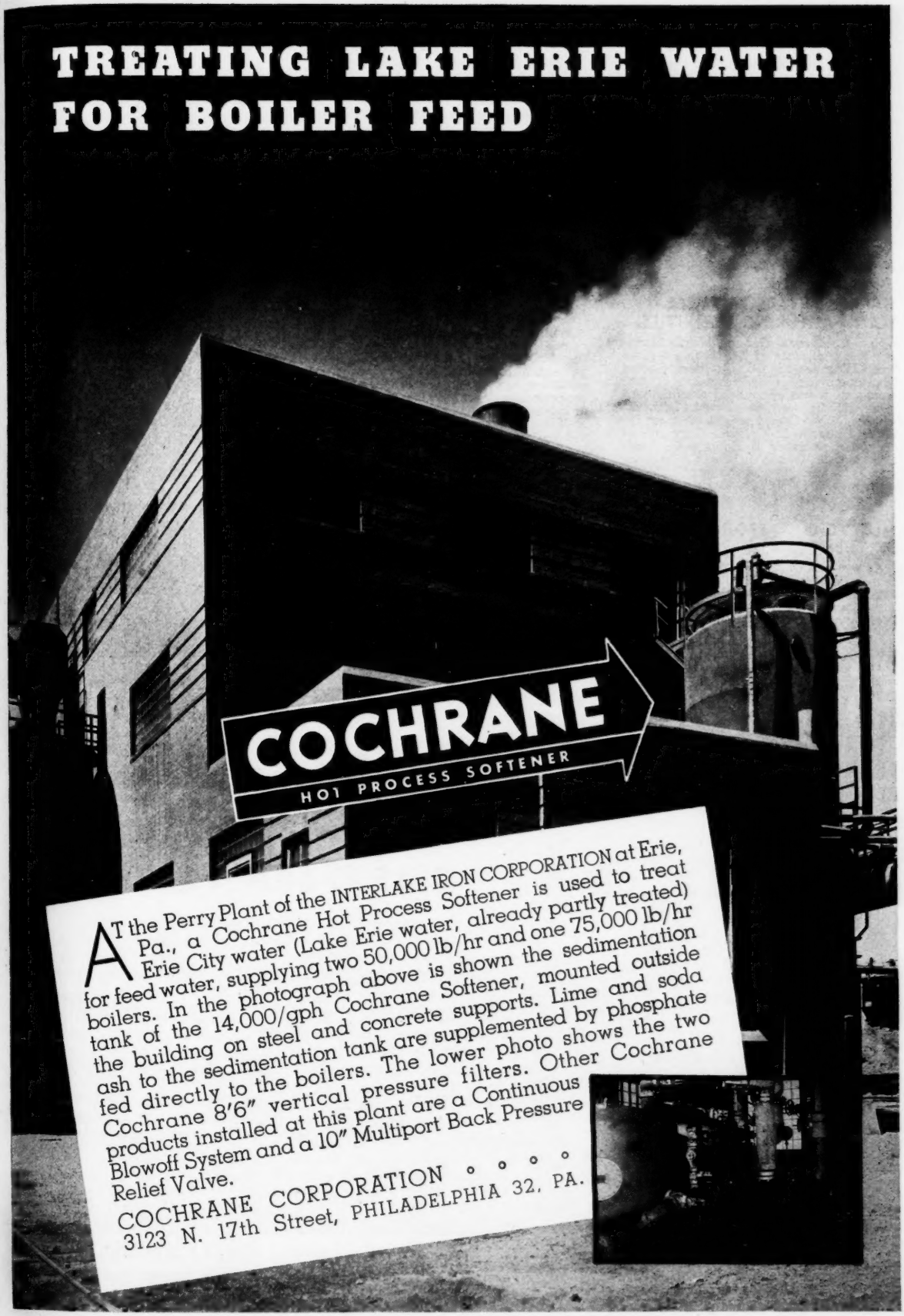
Two IMO pumps employed for supplying hydraulic pressure oil to a combustion control system.

THE DE LAVAL-IMO PUMP is a rotary, positive displacement pump of unique design having *only three moving parts*—a power rotor and two idler rotors. Pump output is uniform at all pressures, making an ideal unit for hydraulic, fuel and governor services.

For further information ask for catalog 1-136-G

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

TREATING LAKE ERIE WATER FOR BOILER FEED



AT the Perry Plant of the INTERLAKE IRON CORPORATION at Erie, Pa., a Cochrane Hot Process Softener is used to treat Erie City water (Lake Erie water, already partly treated) for feed water, supplying two 50,000 lb/hr and one 75,000 lb/hr boilers. In the photograph above is shown the sedimentation tank of the 14,000/gph Cochrane Softener, mounted outside the building on steel and concrete supports. Lime and soda ash to the sedimentation tank are supplemented by phosphate fed directly to the boilers. The lower photo shows the two Cochrane 8'6" vertical pressure filters. Other Cochrane products installed at this plant are a Continuous Blowoff System and a 10" Multiport Back Pressure Relief Valve.

COCHRANE CORPORATION ° ° ° °
3123 N. 17th Street, PHILADELPHIA 32, PA.

ment of D. C. Beaulieu as manager of the new division was announced recently.

Dowell, Inc. has announced the movement of its Chicago office to Room 1402, Fisher Building, 343 S. Dearborn St., Chicago 2, Ill. Phone, Harrison 8686. J. T. Browning is in charge. Dowell will continue to maintain its treating station at Chicago Heights, Phone, C. H. 3124.

MANUFACTURERS' *Personals*

HARRELL HEADS RELIANCE MANUFACTURING ACTIVITIES

FRED E. HARRELL, General Works Manager and a director of The Reliance Electric & Engineering Co., has been elected Manufacturing Vice-President of the company, it was announced recently. All other officers were re-elected. In addition to J. W. Corey, president, they include Clarence L. Collens, Chairman of the Board; Edward E. Helm, Sales Vice-President; P. G. McAusland, Comptroller and Treasurer; Roscoe H. Smith, Secretary; and H. F. Walters, Assistant Secretary and Assistant Treasurer.

McCUTCHAN APPOINTED BY TUBE TURNS

ARTHUR MCCUTCHAN has been appointed Senior Research Engineer of the Product Engineering and Research Department of Tube Turns (Inc.), Louisville, Ky., it has been announced.

Mr. McCutchan will be associated with A. R. C. Markl, Chief Research Engineer, formerly Mechanical Engineer in charge of the Pressure Equipment and Materials Division of the M. W. Kellogg Co.; Mason S. Noyes, Research Engineer, formerly Senior Marine Engineer, Bureau of Ships, U.S.N., and Henry H. George, Research Engineer, formerly a physicist in the Jones and Laughlin research laboratory.

Appointment of F. B. Langreck as technical advisor and J. M. Graham, Jr., and W. Kenneth Menke as assistant directors of Monsanto Chemical Co.'s general development department was announced recently.

Paul R. Wineman has been named manager of the Seattle district of the Industrial Products Sales division of The B. F. Goodrich Co. Mr. Wineman succeeds Fred D. Ranyard, who has retired after near 36 years of company service.

Walter Richter, consulting electrical engineer with the Allis-Chalmers Mfg. Co., Milwaukee, is the author of "Fundamentals of Industrial Electronic Circuits," a new book resulting from his experience in teaching an evening course in industrial electronics at the University of Wisconsin, Extension Division, during the last 10 years.

M. F. Slusser, who for the past four years has been in the industrial sales department of Westinghouse Electric Corp., has been made manager of the construction and communications section of that department.

The Dampney Co. of America, Hyde Park, Boston, has announced the appointment to its sales staff of LaVern Warren Marsh.

Lynn H. Johnson has been appointed sales manager of the gas controls division of Minneapolis-Honeywell Regulator Co. it was announced recently.

FOSTER WHEELER'S HUGE CONDENSERS

THE FOSTER WHEELER CORP. has completed construction of the two largest cross-flow condensers ever built —each unit larger than a complete five-room house.

The condensers, built at the company's plant in Carteret, N.J., are being installed in the Southwark Station of the Philadelphia Electric Co.

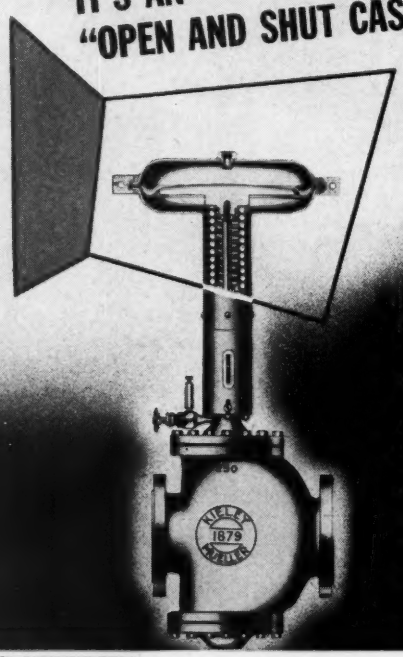
Each unit, measuring 35 ft high, 46½ ft in length, and 20 ft in width, will condense exhaust steam from a turbine of 150,000 kilowatt rated capacity.

To condense the steam, it is necessary to circulate 146,000 gallons of water per minute through the condenser tubes —a volume equivalent to the daily domestic water requirements of more than 6,000,000 persons, or the combined populations of the States of Maine, New Hampshire, Massachusetts, Vermont.

At the higher loads 1,300,000 pounds of steam per hour will be condensed in each unit. The energy absorbed in doing this is equivalent to the total power of a fleet of 70 steam locomtives.

When empty, each condenser unit weighs 660,000 lb, and with water flowing through the tubes it weighs 1,100,000 lb. The tube sheets at each end of the condenser—which support the tubes—are the largest bronze plates ever rolled. They measure 11 ft 7 in x 21 ft 1 in and are 1½ in thick. Each plate weighs approximately 14,000 lb.

IT'S AN "OPEN AND SHUT CASE"



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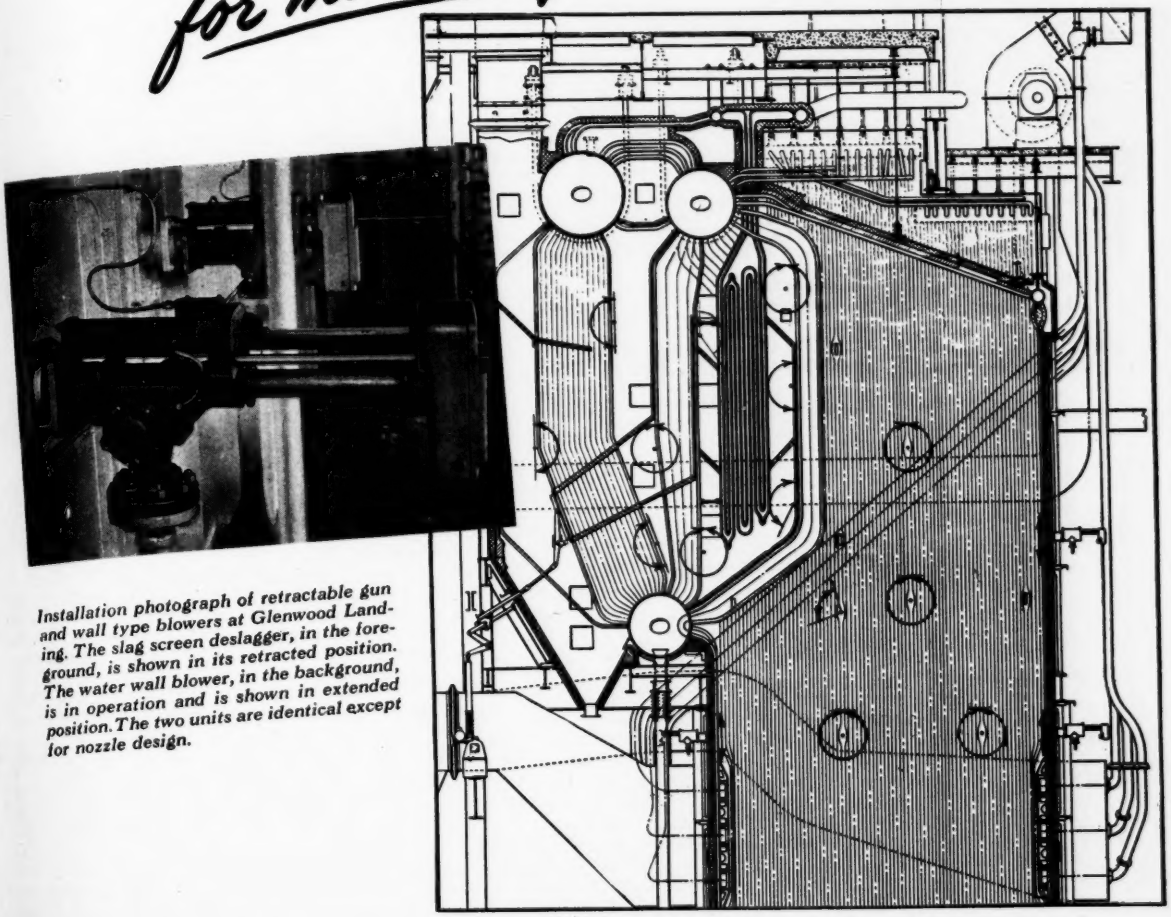
AUTOMATIC soot blowers—

for modern power plants



Installation photograph of retractable gun and wall type blowers at Glenwood Landing. The slag screen deslagger, in the foreground, is shown in its retracted position. The water wall blower, in the background, is in operation and is shown in extended position. The two units are identical except for nozzle design.

The 400,000 lb. per hour Combustion steam generator at the Glenwood Landing Steam Electric Station of Long Island Lighting Company is thoroughly cleaned by a Vulcan Automatic Sequential Air Blowing System. Waterwall deslaggers, slag screen deslaggers, superheater and boiler tube soot blowers are all operated in proper sequence by merely pushing a button on the soot blower control panel. Furthermore, any group of blowers or any individual blower may be operated separately by push-button control.

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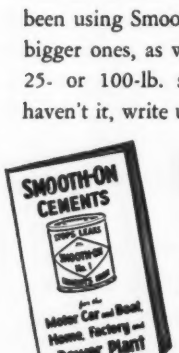

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POWER PLANT *Construction News*

Ala., Jackson—Alabama Power Co., Birmingham, Ala., is reported planning expansion in oil engine-operated generating plant at Jackson, with installation of additional equipment for increased capacity. Also will make extensions in transmission and distributing lines in that area. Entire project estimated to cost approximately $275,000.

Fla., Jacksonville—City Commission plans expansion and improvements in municipal electrical utilities, including modernization and extensions in present generating station and construction of two new power plants, each with rating of about 30,000 kw; extensions in transmission lines, power substation additions and distribution lines. Entire project will be carried out over period of number of months and is estimated to cost about $18,000,000. A bond issue of $15,000,000 is proposed.

Fla., Tampa—Tampa Electric Co., has plans for new steam-electric power plant. Construction award for steel frame superstructure has been made and erection will be placed under way soon. No official estimate of cost announced. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer.

Ill., Rockford—Central Illinois Electric & Gas Co., 301 North Main St., Rockford, has preliminary plans for new steam-electric generating station on Rock River, with turbine-generator, high-pressure boiler and auxiliary equipment for large capacity. Cost reported close to $4,000,000. Initial work is expected to be placed under way later this year.

Ind., Indianapolis—United States Rubber Co., 549 East Georgia St., has plans in progress for new boiler house at local factory. No estimate of cost announced. H. E. Beyster Corp., Industrial Bank Bldg., Detroit, Mich., is consulting engineer.

Ind., Mishawaka—Indiana & Michigan Electric Co., 220 West Colfax St., South Bend, Ind., plans new steam-electric generating station in vicinity of Mishawaka, with installation of turbine-generator units with rating of 190,000-kw, high-pressure boilers and auxiliary equipment. Extensions will be made in transmission lines and power substations in that area. Entire project will require a number of months for completion and will represent a reported investment of about $15,000,000.

Ind., Noblesville—Indiana Public Service Co., Traction Bldg., Indianapolis, Ind., has plans in progress for new steam-electric generating plant on White River, about 4 miles from Noblesville, to be equipped for initial capacity of 30,000-kw. Switchyard will be built and extensions made in transmission lines. Entire project will represent investment of about $7,000,000. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Ind., Rockville—Town officials have engaged John M. Rotz Engineering Co., Merchants Bank Bldg., Indianapolis, Ind., consulting engineer, to make surveys and estimates of cost for extensions and improvements in municipal steam-electric power plant, including installation of equipment for increased capacity.

Kan., Macksville—Town Council plans new municipal power station, with installation of Diesel engine-generator units and accessory equipment. Bond issue of $60,000 is being arranged to provide for project in part. H. B. Breneman is town clerk.

Ky., Henderson—City has plans under way for new municipal power plant to supplement present steam-electric generating station, estimated to cost about $1,900,000, with turbine-generator, boiler and auxiliary equipment. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Ky., Lexington—Kentucky Utilities Co., Lexington, has tentative plans for new steam-electric generating station on Green River, Muhlenberg County, with installation of equipment for large capacity. Cost estimated close to $9,000,000, including transmission lines and switching stations. Also plans expansion in steam-electric power plant at Pineville, Ky., with installation of new 33,000-kw turbine-generator, high-pressure boiler and accessories. Cost approximately $3,750,000.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Cuzinal Combats Impingement Corrosion and Increases Condenser Tube Life

During recent years many changes have taken place in land power plants as well as in those aboard ship. One of the results of these changes is greatly increased cooling water velocity. Larger size pumps are used to push greater quantities of water at higher velocities for faster condensation and greater efficiency. Ships moving through the sea at faster speeds are driven by turbines which also depend upon higher cooling water velocities through their condensers for maximum efficiency.

Increased water velocities and turbulence result in a type of condenser tube failure brought about by impact of the water (with or without entrained air bubbles) on the surface of the condenser tubes. The severity of impingement corrosion varies with the alloy composition, water composition, water velocity and the quantity of entrained air bubbles. Of course, when much entrained air is present in the water, failure of the tubing takes place more rapidly in the case of Admiralty. The effect of water velocity may be recognized in two ways. The leading edges of protruding metal surfaces (such as in test samples) may be rapidly reduced in size. This condition is especially noticeable at the point of impact. Another indication is the formation of impingement corrosion pits which may be recognized by undercutting of the pits as illustrated. The pits that form are quite clean and free from corrosion products of any type. Sometimes these pits have a noticeable tail pointing upstream, and frequently a series of pits will overlap giving a serrated profile when a longitudinal section of tubing is examined.

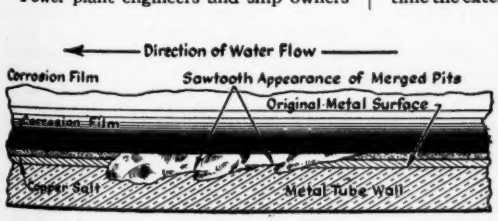
Retubing is Expensive

Power plant engineers and ship owners are, of course, well aware of the factors involved when retubing a condenser—cost of tubing, rising costs of installation, and loss resulting from the period that the condenser is shut down. They realize that anything which will increase condenser tube life, minimize contamination of boiler water and postpone the necessity for retubing as long as possible is well worth while from every practical standpoint. Older condenser tube alloys, such as Admiralty, may have given satisfactory service for many years in a great number of installations. However, ship owners and power plant operators who have been experiencing unsatisfactory service life due to higher water velocities, are turning toward condenser tube alloys designed to withstand impingement corrosion.

One of the best from this standpoint is aluminum brass which was developed in England and made its appearance in the United States around 1930. This type of alloy is more difficult to produce than Admiralty and requires expert casting technique plus powerful tube extrusion presses and tube reducing equipment. Aluminum brass, as manufactured by Bridgeport, is called Cuzinal and consists of approximately 76% copper, 2% aluminum and the remainder zinc plus a small quantity of arsenic which inhibits dezincification and increases corrosion resistance.

Test Shows Cuzinal More Resistant to Impingement

In a recent test*, racks containing more than 200 samples of copper-base alloys were placed in clean, flowing sea water for a period of one year. At the end of that time the extent of corrosion was measured in several ways. At the point of impact, uninhibited Admiralty lost on the average 0.0159 in. Arsenical Admiralty lost 0.0095 in. On the other hand, Cuzinal lost only 0.0019 in. The Cuzinal showed a few local narrow-to-wide pits 0.0002 in. to 0.007 in. deep. On the basis of loss of weight, uninhibited Admiralty showed a value of 10.04 m.d.d. (loss of weight in milligrams per square decimeter per day). The value for Arsenical Admiralty was 8.97, and for Cuzinal 4.47. It has also been found in clean sea water that the corrosion film formed on Cuzinal is thinner than that formed on Admiralty, with a consequent improvement in heat transfer properties.



The wide use of Cuzinal during the war for cargo and transport ships has proven its superiority over Admiralty. A large number of Maritime Commission cargo and passenger ships are using aluminum brass for all condenser tubing. In a great many cases when the question was asked as to what alloy would be used for retubing, on the basis of their experience with aluminum brass, the answer was that aluminum brass would again be used.

Cuzinal is made to specifications A.S.T.M.B111-45TypeB;A.S.M.E.SB111.

Other Corrosion-Resistant Alloys Available

In addition to Cuzinal, Bridgeport manufactures a number of condenser tube alloys designed to stand up under a wide range of water conditions and operating procedures. Arsenical Admiralty for good general corrosion resistance to sea water where velocities are not too high. Cupro Nickel for fine resistance to corrosion from sea water flowing at high velocity. Such alloys as Arsenical Muntz and Arsenical Copper for clean fresh waters. Red Brass for corrosive fresh waters. Duronze IV (aluminum bronze), one of the finest condenser tube alloys, for use under severe conditions such as rapidly flowing fresh or salt water polluted by sewage and industrial wastes, acids, cinders and other foreign matter. It has been very successful in seaboard power plants.

Bridgeport's Laboratory and Technical Service Department are available to help solve corrosion problems and suggest the condenser tube alloy most likely to give longer service under a given set of conditions. Contact them through the nearest Bridgeport office and write for 112-page Condenser Tube Manual containing valuable information about corrosion research, condenser tube alloys, methods of installing and suggestions for increasing condenser tube life.

**Corrosion and Biofouling of Copper Base Alloys in Sea Water by C. L. Bulow—Transactions of the Electrochemical Society, Volume 87, 1945.*

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Mich., Manton—Municipal Light & Power Dept., has plans under way for extensions in generating station, including installation of new Diesel engine-generating unit and auxiliary equipment. Estimates of cost are being made. Francis Engineering Co., Saginaw, Mich., is consulting engineer.

Neb., Bellevue—Central Nebraska Public Power & Irrigation District, 1513 West Second St., Hastings, Neb., R. O. Canaday, secretary, will complete plans soon for new steam-electric generating plant at Bellevue, near Omaha, to be equipped for initial rating of 60,000-kw. Cost about $10,000,000, including transmission lines, power substations and other operating facilities. Bond issue in that amount has been sold. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Mo., California—Town Council has engaged Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer, to make surveys and estimates of cost for expansion and improvements in municipal power plant, including installation of new 850-hp Diesel engine-generating unit and auxiliary equipment.

N.C., Beechertown — Nantahala Power & Light Co., Franklin, N.C., has plans for new hydroelectric generating station on Nantahala River at Beechertown, where site has been elected. A power dam 65 ft high and 405 ft crest length will be constructed. Power house will be equipped with hydraulic turbine and electric generator of about 2000-hp rating. Federal permission has been secured and work will begin at early date.

N.C., Cliffside—Duke Power Co., Charlotte, N.C., plans expansion in steam-electric generating station at Cliffside, with installation of additional equipment for increased capacity. Extensions will be made in transmission lines. CPA has approved project and work will be placed under way soon. No estimate of cost announced.

N.C., Ocracoke—Ocracoke Electric Membership Corp., Ocracoke, plans extensions and improvements in oil engine-operated generating station, with installation of additional equipment for increased capacity. Financing will be arranged through Federal aid.

N.D., Grand Forks—Northern States Power Co., Minneapolis, Minn., has completed plans for addition to generating station at Grand Forks and will begin work early this spring. Additional equipment will be installed for increased capacity. Company also will carry out expansion in power plants at St. Cloud and Mankato, Minn., and will increase output at both stations. No estimates of cost.

Ohio, Springfield—Ohio Edison Co., Springfield, plans expansion in Mad River steam-electric generating station, with installation of new turbine-generator, high-pressure boiler and auxiliary equipment. Cost about $2,500,000. Of this amount, approximately $350,000 will be used for building extension and work on superstructure will begin soon. Project has been approved by CPA.

Ore., Roseburg—California-Oregon Power Co., Medford, Ore., has secured State permission for proposed hydroelectric power development on North Umpqua River, near Roseburg, previously reported in these columns. Work will be placed under way soon. It will consist of an earth diversion dam, 350 ft long, with power house to be equipped with two hydraulic turbines and generators, each with rating of 12,500 kw. Cost estimated about $3,375,000. A transmission line will be built to Dixonville, 11 miles distant, where connection will be made with present high-tension system. Public Utility Engineering & Service Corp., 231 South LaSalle St., Chicago, Ill., is consulting engineer.

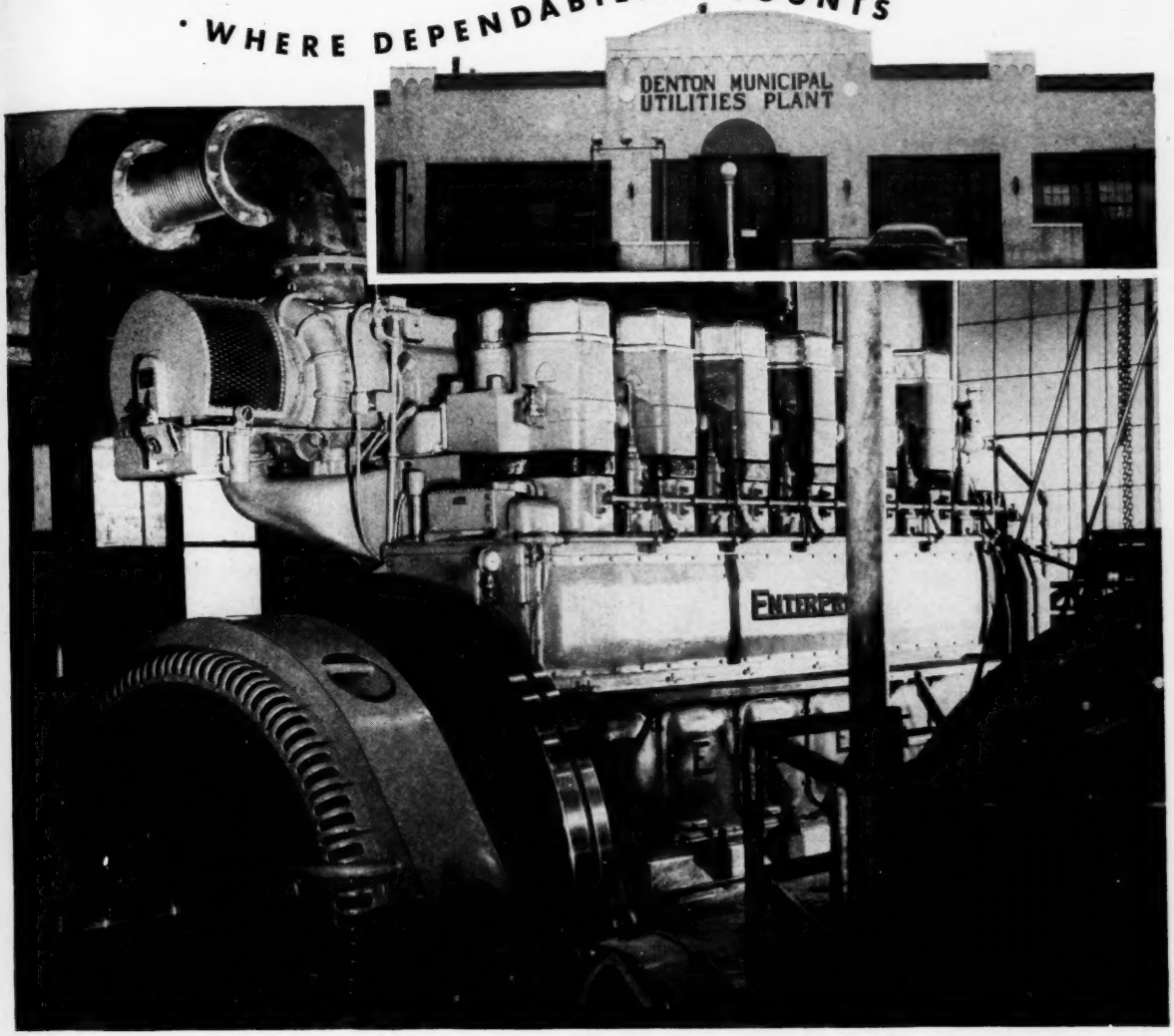
Pa., Scranton—Scranton Electric Co., has plans under way for expansion in generating station, with installation of new 20,000-kw hydrogen-cooled turbine-generator, high-pressure boiler and auxiliary equipment, including coal and ash-handling facilities. Cost reported in excess of $3,500,000.

Tenn., Tullahoma—Town Council plans new municipal power plant, estimated to cost about $600,000. A bond issue will be arranged at early date and engineer engaged to make surveys and plans.

Texas, Dallas—Dallas Power & Light Co., 1506 Commerce St., plans new power substation at Haskell and Dolph Rds., estimated to cost over $750,000, with transformers, switchgear and auxiliary equipment. Proposed to begin work soon.

W.Va., Parkersburg—Appalachian Electric Power Co., Roanoke, Va., plans new steam-electric generating plant on Ohio River, at place known as Graham Station, Parkersburg area. It will be equipped for large capacity and is reported to cost in excess of $15,000,000, including switchyard, transmission lines, power substations and other operating facilities. It is understood that work will begin this spring.

· WHERE DEPENDABILITY COUNTS



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New ENGINEERING BOOKS

English-French and French-English Technical Dictionary, by Francis Cusset; 590 pages; cloth binding; 5 by 6½ inches; published by Chemical Publishing Co., 234 King Street, Brooklyn 31, New York. Price $5.00.

This dictionary is intended for the use of all workers in the fields of metallurgy, mining, electricity, chemistry, mechanics and the sciences. It gives first the listing of words in English with their accompanying French equivalents and then the listing in French with the English equivalent.

No attempt is made to define the various terms nor to give any information about their grammatical usage in either language. However, for the technical man who must read texts and technical periodicals in French, in order to keep up with the newest accomplishments in various foreign countries, this dictionary should prove quite useful.

• • •

Theory and Practice of Filtration, by George D. Dickey and Charles L. Bryden; 346 pages, illustrated; size 6 by 9 inches, cloth binding; published by Reinhold Publishing Corp., 330 W. 42nd St., New York City. Price $6.00.

Filtration appears as an essential part of a multitude of manufacturing processes from sound filtration in radio and telephone operation, to vitamin extraction in medicinal preparations. With this in mind, an all-inclusive volume on all types of filtration would be impractical. Therefore, this book has been limited to the separation of solids from liquids, principally covering the three applications to oil, water and sewage.

The book has been divided into two distinct parts. First, history, theory and principles; second, the various types of filters and data pertaining thereto. The major part of the book deals with filters and auxiliary apparatus, including typical data. All this material is treated without abstruse chemistry or mathematics, yet in such a way that it should be of great value to the practicing engineer in industry.

The various phases of the subject are discussed in the following chapters: History of Filtration; Theory and Principles of Filtration; Filtration Objectives; Preparation for Filtration; Filter Media; Gravity Filters; Pressure Filters; Vacuum Filters; Hydraulic Presses and Squeeze Presses; Laboratory Filters; Oil Filters; Oil Expellers and Oil Separators; Water Filtration; Sewage Clarification and Sewage Sludge Dewatering; Centrifugals and Centrifuges; Air, Gas and Light Filters; Auxiliary Equipment; Typical Filter Applications and Flow Sheets; Testing and Selection of Equipment; Installation and Operation.

The book has an appendix dealing with Surface and Interfacial Tension Separation of Immiscible Fluids and another giving definitions of terms, tables and charts. The book is well indexed.

• • •

What Price Supervision, by R. D. Bundy; 48 pages; size 6 by 9 inches, flexible simulated leather cover; loose-leaf special punched ring binding. Price $2.00.

The Federal Labor Laws—A manual for Supervisors; 72 pages, size 6 by 9 inches, flexible simulated leather cover, special loose-leaf metal ring binder. Price $2.50.

Both published by the National Foremen's Institute, Inc., Deep River, Conn.

The work of the National Foremen's Institute in clarifying and explaining to management, workers and to foremen themselves the relations of the foremen to industry is well known. These two publications are intended to crystallize industrial thinking on these subjects and give foremen material they can actually use in their daily work.

In What Price Supervision, Mr. Bundy discusses how management can build a stronger supervisory force. In Chapter I he outlines a pattern of management-foreman relations, giving views on supervision, outworn policies, measures of leadership, case histories, data on foreman's education and education vs. experience. In succeeding chapters he discusses What is Supervision, illustrates the technique of effective supervision, analyzes values and supervisory worth and points out the great value to industry of a staff of high-grade supervisors.

In the other volume on Federal Labor Laws, it is pointed out that every foreman from the top supervisor down remembers occasions when he should have known the answer to some question of Federal Labor Law but did not know it. Those answers the author has endeavored to compile in this book. Possibly by the time this notice appears, the Congress may have effected substantial changes in the present National Labor Relations Act. But unless this happens, the act and its various interpretations should be known to all foremen in its present form. The book gives first the National Labor Relations Act itself, then the Fair Labor Standards Act, the Walsh-Healey Public Contracts Act. Following this are discussions of Wage Stabilization; The Social Security Act; the U. S. Employment Service; The Fair Employment Practices Committee and Veterans' Rights.

• • •

Steam Trapping and Air Venting, by L. G. Northcroft; 172 pages, illustrated; cloth binding, 5½ by 9 inches; published by Chemical Publishing Co., Inc., 234 King Street, Brooklyn, N.Y. Price $4.50.

This book was written in the conviction that it would show how many of the faults connected with steam traps have been brought about not by steam traps themselves, but because of incomplete knowledge of the way in which they should be used.

Stress is laid on the importance of correct and up-to-date methods of condensate drainage. From the point of view of steam economy and output efficiency, adequate air vent-

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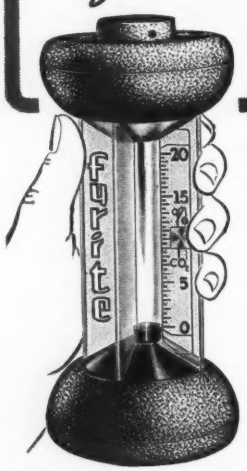

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TOP SPEED UNDER ACTUAL SERVICE CONDITIONS is the way to judge a tube cleaner's ability to do a faster cleaning job. Lagonda tube cleaners have this speed. Their cutter heads *keep on* whirling swiftly when heavy scale tries to slow them down.

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RUGGED CUTTER HEADS PLAY THEIR PART in these faster, more effective cleaners. They're designed and built with the finest materials, with cutters that hold their edges, and vital parts especially heat-treated to insure proper hardness so that they stand up under this extra operating speed and power. Trackless cutters insure against tube injury as well as positively removing every trace of scale.

Use Lagonda Cleaners for tubes straight or curved, large or small. They do a faster, better, all-around job. The bulletin tells why—Write for it today.

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Lagonda
TUBE CLEANERS

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ing arrangements for heating and process purposes are regarded as equally important. These methods are discussed in much detail with many diagrams and illustrations.

Although the work is originally of British origin, the diagrams and technical data apply equally well to American practice. The sole exception is that costs are given in pounds, shillings and pence.

The subject is discussed under the following chapter headings: Steam and Condensate; Steam Trap Types; Steam Trap Installation; Air in Steam Spaces; Low Potential Heat; Heating, Kitchen and Hospital Equipment; Pans and Evaporators; Dryers; Process Treatment by Steam; Ship Installations; Steam Mains, Power Plant and Compressed Air; Sizing Steam Pipes; Sizing of Condensate Return Pipes; Condensation Rates; and Steam Tables.

• • •

What Industry Owes to Chemical Science, by Richard B. Pilcher and Frank Butler-Jones with Fifty Contributors; 372 pages, illustrated; cloth binding, 5½ by 8½ inches; published by the Chemical Publishing Co., Inc., 234 King Street, Brooklyn, N.Y. Price $5.00.

What is the place of the chemist in practical life and what part has he taken in industrial and social development? This book was written to answer that question. Its scheme is based on a former book compiled from articles in *The Engineer* of Great Britain many years ago, but although it follows that scheme it is almost entirely a new book. It is intended for the general reader as well as for chemical students for each chapter has been written by an expert in non-technical language. There is scarcely an industry that does not use the inventions and discoveries of the chemist. Hence a knowledge of what they are doing in various fields is indispensable to the understanding of modern life.

Various contributions are grouped under the following chapter headings: Agriculture; Food; Water Supplies and Sanitation; Pharmaceutical Products; Soaps, Waxes and Glycerin; Disinfectants, Antiseptics and Preservatives; Technical and Other Chemicals; Dyestuffs; Textiles; Pulp and Paper; Synthetic Resins and Plastics; India Rubber; Photography; Coal and Its Products; Heavy Chemicals; Minerals and Metals; Building Materials, Mortar, Cement; Transport, Shipbuilding and Dockyards.

• • •

American Standard Practice for the Inspection of Elevators, Second Edition; Approved by American Standards Association, October, 1945; 125 pages, illustrated; 5½ by 8 inches, stiff cloth binding; published by the American Society of Mechanical Engineers, 29 West 39th St., New York 18, N.Y. Price $1.25.

This manual is intended to serve as a guide for the general use of elevator inspectors. It is based on the requirements of the American Standards Safety Code for Elevators, Dumbwaiters and Escalators and reference to the rules of that code is frequently made in the text. While many legal codes with their additions, amendments, changes or interpretations are based on that code, inspectors should be guided by whatever elevator code is legally enforced.

Following an introduction on personal safety, duties of inspectors, arrangements for inspection and new codes, Part I discusses routine inspection. This includes inspection made from inside of car, inspection made outside of hoistway, inspection made from top of car, inspection made overhead, electric machine inspection, belt drive machine inspection, hydraulic machine inspection, hand-rope mechanisms, slack cable device inspection and inspection made in the pit.

Part II covers initial or data inspection. Part III covers inspection of escalators. Appendices give suggested inspection forms, tables of clearances, safety stopping distances, etc., wire rope construction data, and description and schematic layouts of various types of undercar safeties and governors. One Appendix deals with handling and socketing of wire rope.

• • •

Information Please Almanac — 1947, Edited by John Kieran; 1014 pages, illustrated; size 5½ by 8 inches, cloth bound; planned and supervised by Dan Golenpaul Associates, published by Doubleday & Co., Inc., and Garden City Publishing Co., Inc. Garden City, Long Island, New York. Price $2.00.

Here is an almanac that grew directly from the questions and answers sent to the famous radio program "Information Please." It was designed for the average family that could not afford a collection of reference works; it should be organized to facilitate searching, cover a great variety of interests. The logical man to edit the work was the famous John Kieran, and the information itself was contributed by outstanding writers and authorities in various fields.

The book begins with a review of the year 1946 by such outstanding analysts as Elmer Davis on national and international affairs, Grantland Rice on sports, William L. Laurence covering the development of atomic energy, Bernard Jaffe on developments in the Physical Sciences, etc. This review also covers developments in music, the screen, radio, ballet and dance, phonograph recordings, a news record and discussion of the 1946 elections.

This introductory section is followed by sections of varying lengths and details on the following subjects: United States of America in general; American Economy; National Defense; United Nations; The World; Travel Guide; Calendar and Stronomical Section; Great Historical Events; Headlines of 1930-1945; Who's Who; Religion; and Sports. To make all this information easy to find a very detailed index is provided at the end.

• • •

Machine Design by L. J. Bradford and P. B. Eaton; Fifth Edition; 283 pages, illustrated; size 5½ by 8½ inches, cloth binding; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York City. Price $3.25.

When the first edition of this book was prepared in 1926 by L. J. Bradford, Professor of Machine Design, The Pennsylvania State College, and Paul B. Eaton, Professor

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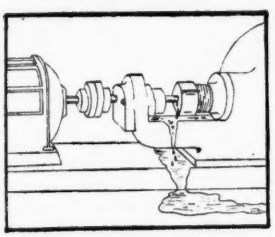

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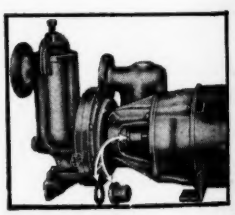

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of Mechanical Engineering, Lafayette College, their primary objective was to present it as a textbook only, for use in courses in machine design where time was limited and more extensive text appeared cumbersome. The book emphasizes fundamental principles and avoids short-cut formulas, graphical methods and available handbook data. The authors believe that if a student really understands the fundamentals involved in the solution of a given problem, he will be able to develop a short-cut formula if he needs one. On the other hand, if he comes into contact with short-cut methods before mastering the fundamentals, he will memorize and use the former without ever understanding it.

In bringing the book up to date in this edition, the authors have reviewed progress made in the field during recent years and have deleted obsolete material. Additions deal primarily with the fatigue of metals, current theories on the nature of friction and lubrication, and special precautions necessary in designing parts made of aluminum. Chapter headings include: Fundamental Definitions and Considerations; Friction and Lubrication; Bearings and Sliding Surfaces; Friction Clutches and Brakes, Shafts; Force and Shrink Fits; Screws and Screw Fastenings; Toothed Gearing; Belts and Chains; Springs; Flywheels; Miscellaneous Machine Elements.

• • •

Fuels and Fuel Burners, by Kalman Steiner; 394 pages, illustrated; size 5½ by 8½ inches, cloth binding; published by McGraw-Hill Book Co.,, Inc., 330 W. 42nd Street, New York 8. Price $4.50.

The author of the well known books "Oil Burners" and "Oil Burner Service Manual" has prepared this one primarily to cover domestic and commercial practice. Industrial fuels and burners have been discussed extensively in power plant periodicals, textbooks and related works. But the fields to which this book is devoted have not had the benefit of considerable treatment. The book is intended for the everyday needs of fuel and fuel burner dealers and salesmen and for installation and service mechanics. Coal, the most extensively used fuel in this country, has received more attention than other fuels. Three chapters on fuel oil and oil burners are condensed from the author's other books and the reader is referred to the abundant literature of the AGA for data on gas and gas burning equipment.

Because over 7½ million families in the United States use wood fuel for heating and in addition, sawmill waste in the Pacific Northwest is utilized extensively in the commercial field, a special chapter on this subject was prepared by R. H. P. Miller of the U. S. Forest Service for inclusion in this book.

Chapter headings include The Fuel Industry; Formation and Occurrence of Natural and Manufactured Fuels; Elements of Combustion; Coal Composition and Classification; Coal Fuel; Hand Firing; Coal Stokers; Stoker Installation and Operation; Fuel Oils; Oil Burners; Oil-Burner Installation and Operation; Gas Fuels; Gas Burners; Fuel-Burner Controls; Load; Chimneys and Draft; Heating-System Control; Fans and Motors, Refractories; Wood Fuel.

Features of the book are the detailed treatment given to domestic types of coal burning equipment, also a rather complete discussion of automatic control methods and apparatus for heating systems. Another unusual feature which should prove very valuable is the list of visual aids:—motion picture films in black and white and color, slide films and film strips available for those interested. Subjects, producers and details of the various available films are listed, with the addresses of companies from which they can be obtained.

• • •

Flow Meter Engineering, by Louis Gess and R. D. Irwin; Second Edition; 151 pages, illustrated; simulated leather cover, 8 by 10 inches; published by Brown Instrument Company, 4491 Wayne Avenue, Philadelphia 44, Pa. Price $2.50.

The second edition of this book expands the information given in the first edition and includes suggestions by users of the first edition to improve its usefulness.

Wherever possible the same symbols for fluid measurements have been used as in the ASME research publication. Derivations of formulas include those of a universal formula for fluid measurement with a thin plate orifice, practical working equations, and the use of the Reynolds' number. Recommendations of the joint AGA-ASME Committee on fluid measurement for orifice installations are included. There are separate chapters on compressibility of gases, orifice calculations for various fluids and the application of correction factors. Many tables of coefficients, density factors, flow rates, differential data and values of various constants are included, and there are many charts and graphs from which data can be read directly. Detailed directions and tables for volume computation are given and much detail on specific calculation of orifices for various fluids, location of taps and other details.

• • •

Water Treatment and Purification, by William J. Ryan; Second Edition; 270 pages, illustrated; cloth binding, 5½ by 8 inches; published by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York. Price $2.75.

The objective of this book is to make available to engineers, plant managers, students, and technical men in general a description under one cover of the several purification and other processes applied to water. Construction and operation of the various types of filtering, softening and treating apparatus are described and illustrated. Chemical reactions occuring in the treatments are also given.

The second edition includes descriptions of processes that have come into use since the first edition in 1937. These include organic ion exchange materials for water softening, acid absorbents, equipment for demineralization of water, latest methods of treating boiler water to prevent embrittlement, new equipment for accelerating the lime and soda ash softening process, new developments in the use of chlorine for sterilization, and stabilization of water to prevent deposition of scale in pipe lines. Boiler feedwater treatment re-

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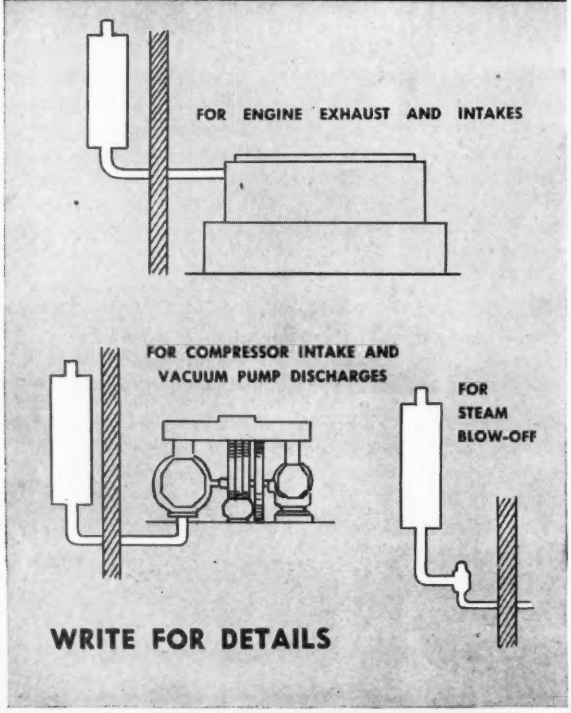

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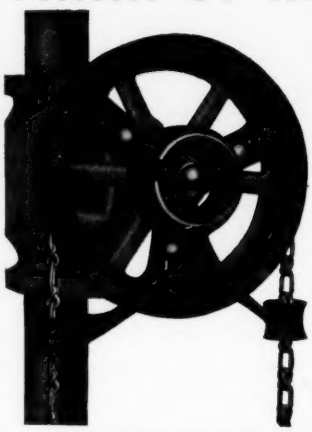

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(ANSWER BELOW)

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2. Good investment! "Getting back $4 for every $3 I invest—the way I will in ten years' time with U. S. Bonds—is my idea of a *good investment.* I know it's safe and sound, too, because it's backed by Uncle Sam. Buy Bonds, I say."

3. Plans for the future! "Ten years from now, the money I'll get for my U.S. Bonds will help to send my kids to college, or buy our family a new home. I think that buying U. S. Bonds is the wisest thing a family man can do."

4. Fights inflation! "I want America to stay economically sound. That's why I'm putting all our extra dollars into U. S. Bonds. It's like buying a share in our country's future prosperity!"

5. Rainy day! "Maybe a rainy day's coming for me. Maybe it isn't. But I am taking no chances. That's why I'm buying all the U. S. Bonds I can through my Payroll Savings Plan."

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ceives a large amount of the discussion because it is of interest to perhaps the largest group of engineers.

The discussion is covered under the following chapter headings: The Impurities in Water; Sedimentation and Coagulation; Filtration; The Analysis of Water; The Lime and Soda-Ash Process; Ion Exchangers; Boiler Feed-Water Treatment—General Considerations; Boiler Feed-Water Treatment—Methods Used; Disinfection of Water; Tastes and Odors; Miscellaneous Treatments; Prevention of Corrosion.

An appendix gives tables of equivalent conversion factors and chemical data and there is an interesting map showing average hardness of water by states.

• • •

Refrigeration Theory and Applications, by H. G. Venemann; second edition; 236 pages, illustrated; size 6 by 9 inches, cloth binding; published by Nickerson & Collins Co., 433-35 N. Waller Ave., Chicago 44, Ill. Price $4.00.

Fundamental principles involved in the process of refrigeration, with applications, are given here to assist the student and engineer to design, maintain and operate plants. This second edition has been enlarged and rearranged so that the actual operating cycle is thoroughly discussed before taking up the theoretical. This was done in the interests of those engaged in operation and maintenance work.

Working pressure—enthalpy charts covering air, ammonia, carbon dioxide, Freon 11, 12, 22, 113, methyl chloride, sulphur dioxide, as well as pyschrometric charts for low and normal temperatures, are included in a loose-leaf pocket in the book.

The subject is covered in the following chapter headings: The Compression Refrigeration System or Electric Refrigeration; Energy Transformations; Refrigerant Charts and Their Uses; Property Changes During Test; Calculations of Results of Sample Test; Analysis of Actual Plant Performance; Performance of Compressors; Instructions for Starting Plants in Operation; Refrigerants; Miscellaneous Methods of Refrigerating; Air as a Primary Refrigerant; Air and Water Vapor Mixtures; Plant Analysis via Theoretical Cycle; Methods of Accommodating Variable Loads; Heat Exchangers for Cooling Air; Heat Exchangers for Cooling Liquids; Heat Exchangers — Condensers; Automatic Controls; Estimating Plant Loads; Specifications for Refrigeration Plant.

• • •

Atmospheric Exposure Tests on Non-Ferrous Metals; Report of Symposium held at ASTM 1946 spring meeting, size 5 by 8 inches, paper bound, 146 pages, illustrated, published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., price paper cover, $1.75, clothing binding $2.25

This symposium, by a number of authorities in various metallurgical fields, evaluates a wide series of atmospheric exposure tests carried out over many years on non-ferrous metals and alloys. Some of the tests have been under way for over ten years. Corrosion of rolled zinc in the outdoor atmosphere is discussed by E. A. Anderson of The New Jersey Zinc Co. This is followed by a paper on the behavior of nickel and monel in outdoor atmospheres by W. A. Wesley of the International Nickel Co., and then A. W. Tracy of The American Brass Co., describes the resistance of copper alloys to atmospheric corrosion. G. O. Hiers covers the use of lead and tin outdoors, while E. H. Dix, Jr., and R. B. Mears of Aluminum Co. of America, deal with the resistance of aluminum-base alloys. The final paper intended to be a summary is entitled, "Tracing Troubles in Atmospheric Corrosion Testing" by P. S. Olmstead, W. E. Campbell and H. G. Romig, members of Technical Staff, Bell Telephone Laboratories, Inc.

Included are certain reports of the ASTM Committee B-3 on Corrosion of Non-Ferrous and Alloys, photographs of samples and extensive tabular data showing the results of examinations of samples.

• • •

Radiant Heating, by T. Napier Adlam; 472 pages, illustrated; imitation leather; 6 by 9 inch; published by The Industrial Press, 148 Lafayette St., New York 13, N.Y. Price $6.00.

Although radiant (or panel) heating of buildings has been growing rapidly in popularity for years, references to the subject have been almost entirely isolated technical papers, articles, or relatively brief publications of manufacturers of pipe and tubing. The present need for a really comprehensive treatise is met by this book. Practical in its approach, it covers complete information on design, installation, and control of hot water, steam, warm air, and electric radiant heating systems for buildings. In addition, the related, but relatively new, subjects of snow melting and radiant cooling are discussed in detail.

The author was associated with A. H. Barker when the latter obtained the first patents on radiant heating in England and has had over thirty years' experience with radiant heating in all its present known phases.

Intended for engineers, contractors, architects, builders and others concerned with building heating and snow melting for walls, driveways or airports, this book is a working manual. Among the 309 illustrations are 64 full-page charts for determining pipe size and spacing. Data on effect of floor coverings are included. Formulas have been reduced to the simplest terms. Charts give most of the essential design data. Exact step-by-step procedure in designing and installing is summarized.

Chapters include: those on theory of heat radiation; artificial heating as related to bodily heat losses; measurement of comfort; determining mean radiant temperature; temperature studies in radiant heated rooms; radiant heating with ceiling panels; radiant heating with floor panels; use of wall panels, metal panels, and electricity; air venting and flow adjusting; controls for radiant heating; areas and surface temperatures of radiant heat panels; determining panel type size, spacing and heat input; radiant cooling and air conditioning; snow melting by embedded pipes; and step-by-step procedure in radiant heating design.

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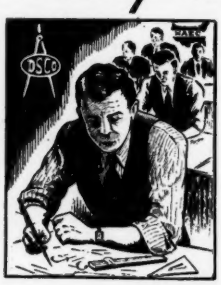

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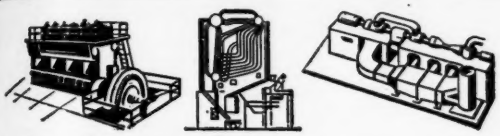

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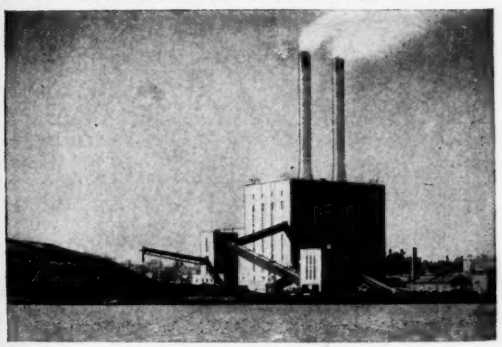

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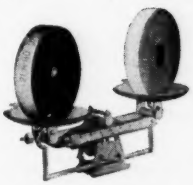

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NEWS FROM THE FIELD

(Continued from page 136)

DETROIT EDISON'S CONSTRUCTION PROGRAM

DETROIT EDISON Co. in January announced a four-year construction program which calls for the expenditure of $96,000,000 to increase the power-producing capacity of the system by 22.4 per cent. Expenditures for 1947 will approximate $20,000,000, the highest since 1930.

Out of the $20,000,000 will come the final payment on a 75,000 kw turbine-generator at the Marysville plant which will be put into operation February 14. Out of that sum also will come the first payment on the installation of two 100,000 kw turbine-generators at the Trenton Channel plant. The first of these is scheduled to go into service in 1949. Their total cost, with housing, boilers, stacks and other necessary equipment will be from $26,000,000 to $30,000,000.

Costs of the 1947 program are divided approximately as follows: Power plants and substations—$7,000,000; transmission and distribution lines, transformers and meters—$10,000,000; buildings, steam heating and gas extensions and construction and automotive equipment—$3,000,000.

WEST PENN VETERANS' PROGRAM ANNOUNCED

AT THE BEGINNING of the 25th year of the West Penn Veterans Association, a new program recognizing those who have given 20 or more years of service to the West Penn Co. has been announced by Pres. H. L. Mitchell. The program includes three weeks' vacations and aninversary checks for Veterans, in addition to the presentation of emblems and a resumption of the annual banquet.

During the war years, the annual banquets which always highlighted the Veterans Association program were, of necessity, cancelled. The Executive Committee of the Association has been studying ways and means for renewing this event, and other methods of honoring West Penn's long service- employes. The Committee's recommendations have now been approved and are announced in a letter sent by Mr. Mitchell to all members of the Veterans Association.

President Michell's letter reveals that the Veterans Association, which held its first banquet in 1922, has grown from a membership of about 70, until today more than 1300 employes are members.

G.E. BUILDS HUGE MACHINES

LARGEST EDDY current power absorbing machines ever to be built at the General Electric Co.'s Ft. Wayne Works are now being built for the Wright Aeronautical Corp., N.J. These 5000-hp machines cannot operate as motors, but can, being water cooled, absorb huge amounts of power. They will be used to load a prime mover, or power source, which spins at a high speed. The power of the prime mover will be transmitted to the machines through a torque meter and gear reducer. These machines are actually dynamometers since they are capable of measuring power. The eddy current type of dynamometer is characterized by its simplicity and compactness for a given horsepower rating, as compared to other types of d-c or a-c machines.

NOTED CHEMIST JOINS BUREAU OF STANDARDS

DR. HOMER D. HOLLER, noted chemist and one of the leading authorities in the field of underground corrosion, has been appointed to the staff of the National Bureau of Standards, according to a recent announcement. Dr. Holler, who has directed pioneering studies in electrochemical and corrosion work in two former tours of duty at the Bureau, will work with Dr. I. A. Denison of the Underground Corrosion Section . He joins the Bureau's staff from the Westinghouse Electric Corporation where he has been responsible for corrosion investigation and control since 1929.

Because of his wide experience and study in the field of electrochemistry, Dr. Holler will initiate a new phase of the work dealing with underground corrosion which the Bureau has been studying for many years. The program will be directed toward more fundamental studies of underground corrosion utilizing the data resulting from an extensive engineering program involving the burying and later excavation of many thousands of specimens of pipe of assorted materials and with various protective coatings. The problem of the deterioration of underground metallic structions has become critical with the sharp increase in the miles of underground gas, oil, and water pipelines. It is estimated losses due to such corrosion amount to $100,000,000 annually.

NEW DIRECTORS FOR ASA

THE ELECTION of six directors to the board of the American Standards Association was announced recently by Frederick R. Lack, president of the Association and vice president in charge of the radio division of Western Electric Co.

All of the directors will serve three year terms. They are: R. L. Pearson, vice president of the New York, New Haven and Hartford Railroad Co. who will represent the Association of American Railroads; Curtis W. Pierce, president of the National Fire Protection Association and president of the Factory Insurance Association who will represent the fire protection group; J. H. Hunt, director of the new Devices Section of General Motors Corp. who will represent the Society of Automotive Engineers; J. H. McElhinney, vice president of Wheeling Steel Corp. who will represent the American Iron and Steel Institute; R. Oakley Kennedy, recently re-

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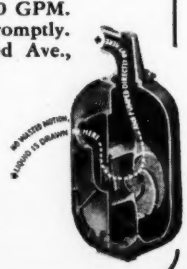

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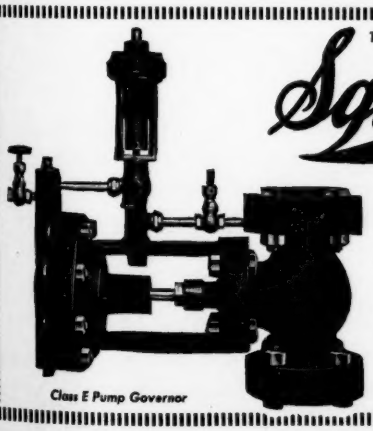

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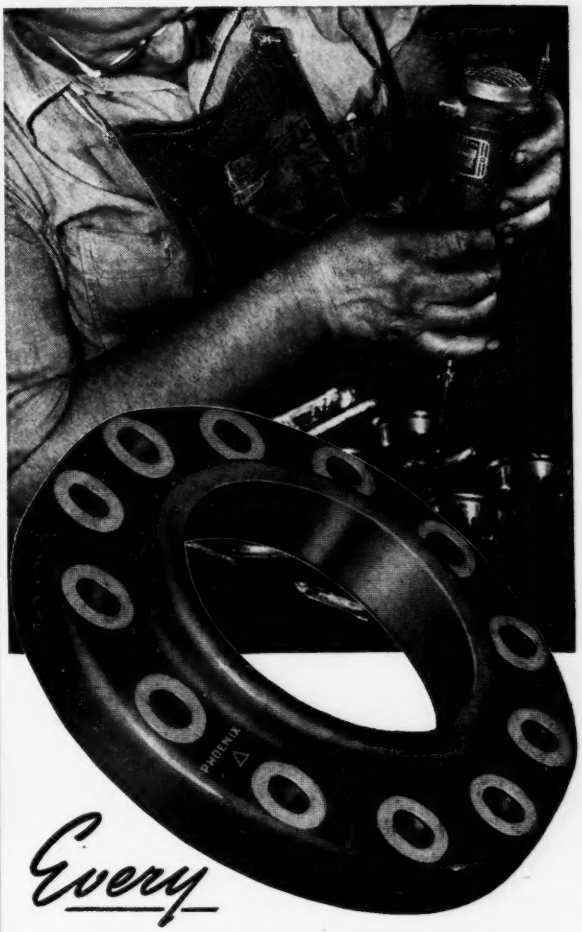

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tired vice president of Cluett, Peabody; will become one of three directors representing general consumer interests on the board; August G. Pratt, president of The Babcock & Wilcox Co. who will represent the American Society of Mechanical Engineers.

CROCKER GETS NEW POST AT DETROIT EDISON

SABIN CROCKER of the Detroit Edison Co. has been appointed to the new position of mechanical engineering consultant. He will report in a staff capacity to Samuel M. Dean, chief engineer of the system to undertake special assignments in the field of system engineering.

Harvey A. Wagner has been appointed senior engineer-mechanical and will report directly to Mr. Dean. He will be responsbile for the operation of the mechanical engineering section of the engineering division of the company. Mr. Wagner is a graduate of the University of Michigan and came to the company in 1928.

MELLON NEW C.E. OF ALLEN-BRADLEY

J. J. MELLON, who has been associated with the Allen-Bradley Co., Milwaukee, for the past two years, has been appointed Chief Engineer of that company.

Mr. Mellon has been active in the development of industrial electric control equipment since his graduation from Rensselaer Polytechnic Institute in 1923. He has held important engineering and executive positions with Westinghouse Electric & Manufacturing Co. and Clark Controller Co., and during the past two decades has been active on the engineering and advisory committees of the Industrial Control Section of the National Electrical Manufacturers Association.

He will take over the activities formerly directed by Gustav O. Wilms, who recently went into semi-retirement to enable him to spend his winters in Florida. Mr. Wilms will continue to serve the Allen-Bradley Co. on a consulting engineering basis.

PUBLIC SERVICE N.J. CONSTRUCTION BUDGETS

CONSTRUCTION budgets for 1947, totaling more than $34,000,000, have been authorized by the subsidiary operating companies of Public Service Corp. of New Jersey for new equipment, extensions and replacements. This is in addition to $23,000,000 previously appropriated for the new Sewaren Electric Generating Station and also is in addition to $6,000,000 appropriated earlier in 1946 for gas works equipment and distribution mains, and $4,900,000 for the purchase of 417 new buses.

Of the total amount in the 1947 construction budgets, approximately $23,900,000 is for the Electric Department and $7,900,000 for the Gas Department of Public Service Electric and Gas Co.; $1,700,000 for Public Service Coordinated Transport and Public Service Interstate Transportation Co.; and $800,000 for Atlantic City Gas Co., Peoples Gas Co. and County Gas Co.

ACCIDENT PREVENTION MANUAL

AFTER TWO and a half years of research and preparation, the National Safety Council has published its new "Accident Prevention Manual for Industrial Operations," which the Council believes is the most comprehensive treatment of the fundamentals of safety available in one volume.

The 544-page manual, containing 400 illustrations, charts and tabulations, is intended as a handy and authoritative source of accident prevention information for safety directors, safety engineers and foremen. Each of the fourteen major divisions of the book is preceded by a summarizing index for quick location of general topics, while a twelve-page detailed alphabetical index at the back gives access to details.

The manual is available to both members and nonmembers of the Council. Further information may be obtained by writing the National Safety Council, 20 North Wacker Drive, Chicago 6, Ill.

BREAK GROUND FOR $10 MILLION PLANT

GROUND was broken Feb. 12 for the new $10,000,000 Corn Products Refining Co. plant at Corpus Christi, Texas. The plant, whose process was developed after years of research, will manufacture starch and sugar from milo maize.

Present for the ground breaking ceremony were officials of Corn Products Refining Co., Corn Products Sales Co. and The H. K. Ferguson Co., industrial engineers and builders in charge of the design and construction program. Local and state officials attended the ground-breaking ceremony, as well as a banquet in Corpus Christi that evening.

USDI PUBLISHES PAPER ON PITTSBURGH COAL

"WASHING Characteristics of the Pittsburgh Coal in a High-Sulfur Area in Greene County, Pa.," by Thomas Fraser and William L. Crentz, has just been published as Technical Paper 689 by United States Dept. of the Interior. It is for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D.C. for 15 cents. Contents covers the experimental program, test procedure, interpretation of data and conclusions.

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